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WORLD OIL

SPECIALIZED FOR EXPLORATION, DRILLING,
PRODUCING OPERATIONS AND MANAGEMENT

JULY, 1954

Gulf Publishing Company

Williston Basin Issue

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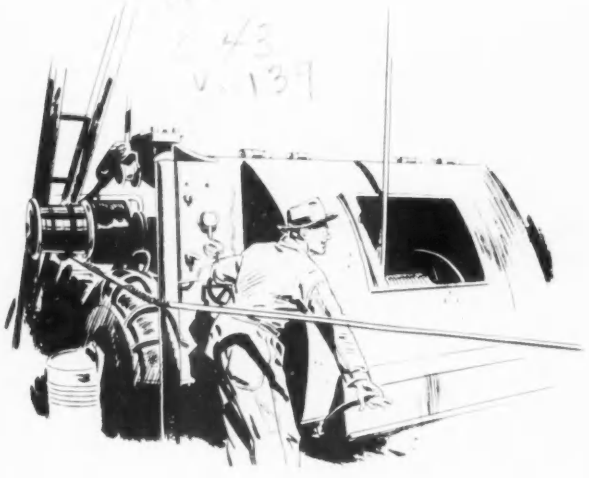

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WORLD OIL

Established 1916 as The OIL WEEKLY

Vol. 139, No. 1

July, 1954

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a quick look at WORLD OIL THIS MONTH

BUSY OIL MEN: To help you put first things first, scan these time-saving digests on this and the following pages, checking ☑ those you want to read first.

CURRENT OUTLOOK

☐ **A tremendous future discovery task** faces the petroleum industry of the U. S. Much faster population growth will cause more rapid oil and gas consumption gains. This will make it necessary for far larger volumes of oil and gas to be found in the future than required in the past. More exploratory work, expanded drilling activity and higher producing operations will be needed. See Page 58. Higher Oil and Gas Producing Rates Lie Ahead of the U. S. ..... Warren L. Baker

☐ **Can sufficient oil and gas be found** to supply the growing population of the U. S. 20 years hence? What areas will furnish the enlarged quantities

Turn the Page ➧

THIS MONTH . . .

which will be needed? Five prominent geologists think much additional new oil and gas can be discovered during the next 20 years. They were asked to participate in a symposium on this subject. **Where Will Future U. S. Oil and Gas Supplies Come From?** . . . . **Page 61**

☐ **Gasoline output must be reduced.** The economic outlook for petroleum is not encouraging at this time. The supply of both crude oil and motor has been too high. Increase in consumption has been comparatively small. Consequently the industry has not been able to reduce excessive inventory levels. Chief headache is excessive gasoline inventories. While the present outlook has taken this dark turn, what's the future picture? See **Page 80, Report from the Observatory** . . . . . **Ray L. Dudley and Warren L. Baker**

☐ **The long, bony arm** of federal regulation reached out to the gas industry last month when the Supreme Court held that Phillips Petroleum Company is a natural gas company subject to FPC jurisdiction in interstate sales. What does this mean to the industry? And what does industry plan to do about it? For a quick digest of the facts on a problem of high importance, see . . . **Gas Decision Affirmed** . . . **Page 82**

WILLISTON BASIN ARTICLES

☐ **Still a challenging frontier . . .** seldom has a new oil province attracted such widespread attention as the Williston Basin. Sparked by Amerada's sensational discovery in 1951, the basin today boasts 66 oil and four gas fields with more than 700 producers from 15 different horizons. For a complete roundup plus a color map showing fields, county lines, and principal towns read **Williston Basin Still a Challenging Frontier** . . . . . **Page 92.**

☐ **What about the geology of the area?** All the factors necessary to make it a major oil-producing province are known to exist in the vast Williston Basin—approximately 450 miles wide and 600 miles long. The general geology of the area is discussed in an article beginning on **Page 104. Geology Points to a Major Oil Province** . . . . . **Edward L. Mueller**

☐ **What about taxes,** laws, conservation measures, and other oil regulations? North Dakota, through far-sighted legislation, has gone a long way toward laying the foundation for orderly development of its oil and gas resources. For details of current regulations, read **North Dakota Oil Laws Encourage Operations** . . . . . **Page 114**

☐ **King of the Williston Basin.** "There's oil in the Williston Basin, but I wonder if I'll live long enough to see it." Tom Leach once made this remark to a friend. And when in the fall of 1950, Amerada Petroleum Corporation recovered a single pint of oil on a test drilled on the Nesson anticline of Williams County, North Dakota, it was Tom Leach's big moment. **The Big Moment for Tom Leach** . . . . . **Page 116**

EXPLORATION ARTICLES

☐ **What about exploration problems** in the Williston Basin? Primarily they are based on lack of real knowledge regarding the conditions which control oil accumulation. The answers can come only through extensive drilling and careful analysis of each well through accurate electric logging, sampling, and coring. Exploration methods used and recommended practices are discussed in an article beginning on **Page 119. Exploration Problems and Procedures in the Williston Basin** . . . . **Richard A. Pohly and Steven H. Harris**

DRILLING ARTICLES

☐ **Worm-hole drilling . . .** that's the tag some drilling people have hung on ultra-slim hole techniques. Ultra-slim holes can now be considered past the experimental stage. One rig operating in California is designed to drill from 3000 to 6000 feet with 1¼-inch drill pipe. For a complete report on one of California's most interesting rigs, turn to **Page 139. Ultra-Slim Hole Rig Uses 1¼-Inch Drill Pipe** . . . . . **Gilbert M. Wilson**

☐ **A Williston Basin wildcat** was so "engineered" that the operator was able to make more than two miles of open hole stand up without setting the usual intermediate string of casing. That's the record of Sun Oil Company's wildcat ten miles northwest of

WORLD OIL, published every month except semi-monthly in February and August. Entered as THE OIL WEEKLY as second class mail matter December 23, 1916, at postoffice at Houston, Texas, under the act of March 3, 1879.

Sidney, Mont. The company saved an estimated $40,000 on the well. How this was done is told in a story beginning on **Page 150. 12,000 Feet of Open Hole!**.....**Charles C. Rossman**

☐ **Williston Basin mud programs** vary widely, but must be controlled properly because of the long exposed sections of shales and bentonite. Starting on **Page 154** is discussion of the various muds used, their advantages and disadvantages, and the applicability to the lithology of the basin. Muds discussed include gypsum-base, lime-base, high pH red mud, and barium carbonate mud. **Drilling Mud Programs in the Williston Basin**.....**Homer H. Brown, Jr.**

☐ **The fluid coupling** grew out of a need for a method to prevent snap stretching of chains . . . to improve clutching . . . to reduce bearing loading . . . and to extend engine life. But what are they . . . and what do they do? WORLD OIL's Anthony Gibbon went to experts with the question. For the answers, turn to **Page 158. Fluid and Dumping Couplings . . . What Are They? . . . and What Do They Do?**. . .**Mel Woodward and Anthony Gibbon**

A demand publication . . .

With this issue WORLD OIL re-dedicates itself to improved service to the drilling and producing branches of the industry.

In answer to a demand prompted by the tremendous growth of the pipe line industry, our pipe line section has been "spun off" into a separate monthly magazine—PIPE LINE INDUSTRY.

This separation of content will fulfill a two-fold purpose of permitting more intense concentration on the drilling-producing branches by WORLD OIL and of more adequately serving the needs of the pipe line industry, which has now reached adult status. Pipe line mileage has jumped from 208,000 miles in 1930 to 330,000 miles. Pipe line investment has risen from $800 million in 1922 to well over $8 billion.

The new magazine will be under the guidance of Ray L. Dudley, publisher and president of Gulf Publishing Company, who pioneered the conception of specialization in the petroleum publishing field; Warren L. Baker, editorial director of WORLD OIL, who will occupy the same position with the new periodical; and Donald M. Taylor, who had ten years' experience in the engineering field before joining WORLD OIL as pipe line editor.

See advertisement pages 18-19 of this issue

PRODUCTION ARTICLES

☐ **What about Williston production problems?** The East Poplar Unit pool is just south of the Canadian border and is one of the most prolific fields of the region. There are four primary production problems here:

- Excessive paraffin accumulations
- Salt deposits
- Severe winters
- Floods

For details on how these production problems are solved, read the article starting on **Page 183. Poplar Unit Operators Face Varied Production Problems**.....**J. Harold Milam**

☐ **How to successfully fracture** Illinois Basin formations is explained in an article starting on **Page 186.** Case histories relate several stimulation jobs, the results of which were effected by several primary factors. A study of these wells indicated the influence of each factor on the probable success of a fracturing job in the Illinois Basin. These factors are discussed briefly. Diagrams and electric logs of four key wells are presented in addition to core analysis date for comparison. **Fracturing Formations in the Illinois Basin**. . **G. H. Link**

☐ **After five years, a report . . .** high-pressure gas injection to increase ultimate recovery from a solution-gas drive reservoir was a new idea back in 1949. From the field research laboratories of The Atlantic Refining Company at Dallas came proof that it would increase considerably the oil recovery. On October 1, 1952, full-pressure maintenance was under way. The idea was that high-pressure gas would cause much of the oil usually left behind to vaporize and recondense at the gas-oil interface. Now a report indicates that after five years the project is going good. For more details, turn to **Page 192. Five Years of High-pressure Gas Injection in Block 31 Field**.....**V. M. Hollrah, R. E. Howard and E. F. Herbeck**

☐ **Where does the water go?** This is an age-old question asked time and time again by producers operating water-flood projects. Many floods are based on the hypothesis that the formation is homogeneous. This is not usually the case and complicates the control of fluid migration. Two new injection tracers were tested recently and proved useful tools for this purpose. Iodide and copper salts can be used to track down in-

Turn the Page

jection water to determine where it is going with respect to offset wells. Actual field results of these are given in an article beginning on **Page 201. New Water-Flood Tracers Prove Successful**.....**A. W. Garst and B. B. Wood**

☐ **A safe and convenient system** of automatic controls for water-flooding equipment has been devised by several major oil companies, working in cooperation with electrical engineers in the Mid-Continent area. Objective has been greater flexibility, reduction in spare parts, ease of installation, and simplicity. Turn to **Page 206** for a description of the hookup and operational procedures. **Auto Controls Standardized for Water-Flood Systems**.....**Anthony Gibbon**

INTERNATIONAL ARTICLES

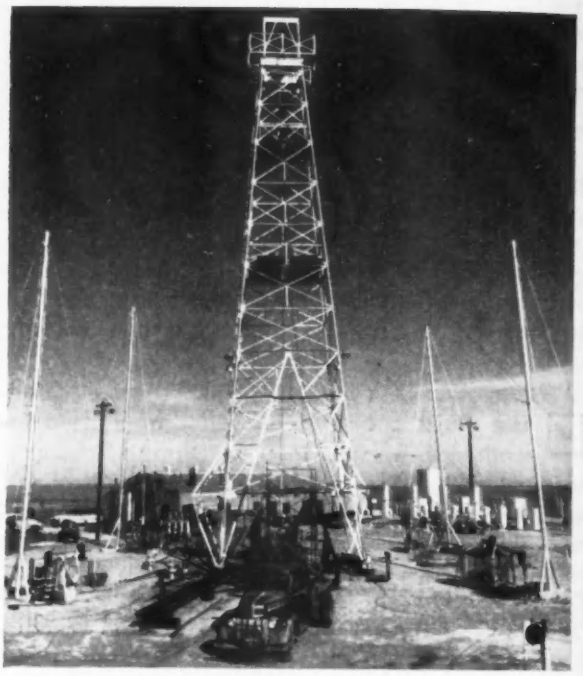
☐ **Europe's largest producing oil well** resulted from the French government's granting, for the first time, an exploration concession to a foreign private capital entity. For details of how this buoyed that nation's petroleum outlook and for the political and economic significance of the discovery, turn to **Page 219. Private Enterprise Scores Again**..**Robert E. Spann and Don Kliewer**

☐ **Cuba had hope . . .** but not much oil for many years. Always there's been that hope that a major discovery could be brought in among the island's sugar cane fields. That hope has now been fulfilled. Turn to **Page 220** for a report on the significance of the discovery. **Cuban Wish Comes True**....**Anthony Gibbon**

☐ **The price is high.** Roumania, least sovereign of the Russian satellites, is paying a dear price for Soviet-demanded crude output . . . extremely shortened life span of its producing wells. One of WORLD OIL's regular contributors on foreign affairs tells the story of Roumanian oil in a two-part article that begins on **Page 224. Time Running Out for Roumania's Oil**.... **George Rosu**

☐ **Ban may be lifted.** For nine years Venezuela has imposed a ban on granting of additional concessions in the Apure-Barinas Basin. But the ban is expected to be lifted. For an accounting of the interest with which the oil companies view the basin and why, read **Apure-Barinas Concessions Ban May End** . . . . . **Page 230**

NEXT MONTH . . .



In-Situ Combustion . . .

. . . you've read about the theory, the laboratory experiments, and the mathematical calculations involving underground combustion of an oil reservoir to aid the recovery of thick crudes. Magnolia Petroleum Company researchers call their field project in southern Oklahoma In-Situ combustion. We were asked . . . just what does the field installation of such a research project look like? So we visited the project . . . took numerous photographs, and got a good idea of what's going on. We found the equipment and hookups were much more familiar than the process itself.

Next month WORLD OIL will take our readers on a quick tour of Magnolia's facilities for In-Situ combustion . . . with pictures like the one above showing the surface installation.

This is one of the highlights of the August 1 issue!

And on August 15 . . .

. . . the annual International Operations Issue will be coming your way. For the second time, this issue will be combined with the annual Mid-Year Outlook Issue. This 2-in-1 combination will offer a roundup of oil and gas activities throughout the world.

This issue will feature the usual WORLD OIL maps of oil-producing nations of the world plus an insert map in color of Middle East areas. Also in this issue . . . the popular WORLD OIL mid-year drilling survey and forecast.

Watch for the two big issues of WORLD OIL in August!

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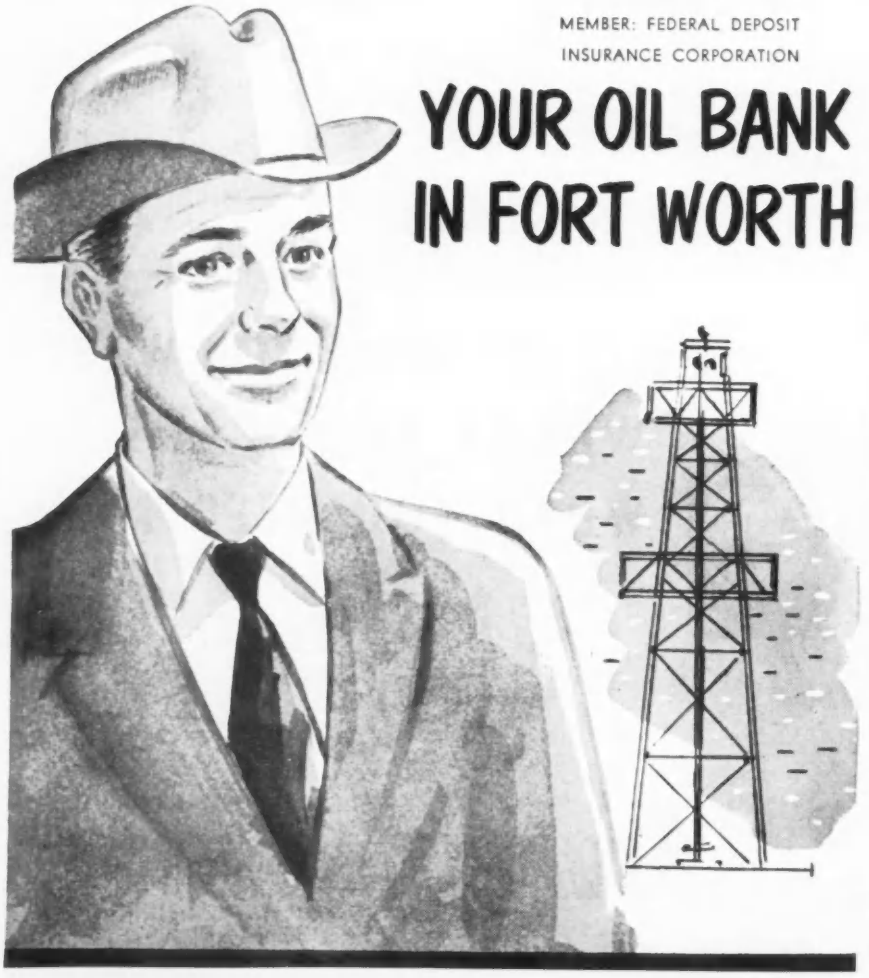

LETTERS

Time Taken to Task

Sirs:

Here is a letter sent to *Time* magazine and outlining my reaction to the article on Texas oil millionaires.

•

"For a news magazine usually well-informed and well-read *Time* grossly fumbled the ball on its story of Texas millionaires, *Time*, May 24, 1954. While the oil industry has its share of colorful characters—as do the steel, coal, automotive, textile, lumbering, film, cattle, etc., industries not to mention the various labor unions, the implication that making a fortune in the oil business depends on government largesse in the form of a depletion allowance is an insult to the intelligence of the millions of people deriving thir livelihood directly and indirectly from the oil industry.

"If you had checked your material before making so many general statements you would have found that the 27½ percent depletion allowance did not make Mr. Murchison and the others mentioned wealthy. Their wealth stems from the old days when big fields were being found more frequently and they had the nerve and gambling instinct necessary to find the oil. Their major discoveries were made during the 35 cents-a-barrel days and their fortunes were amassed in later years by judicious investments in other industries as well as the oil business.

"*Time* might have mentioned that today out of some 10,700 pure wildcat wells drilled annually at an average cost exceeding $40,000 each only 13 percent are productive and only about 5 percent find enough oil to be considered profitable.

"Instead of the 27½ percent depletion allowance being 'the tax bonanza enjoyed by all oil men' it is actually the only incentive making it possible for the small operator to stay in business. The small operator, incidentally, drills about 77 percent of the wells in this country and is largely responsible for maintaining this country's oil reserves at a safe level.

"When an oil man finds a new oil pool he does not become the possessor of an inexhaustible source of wealth. The day the first barrel of oil is withdrawn from the reservoir, depletion of his resources begins. He is not in the position of the farmer who has 500 acres of productive land or the rancher who markets 1000 head of cattle annually. In time the oil man's 'ocean of oil' is just a trickle in the barrel and unfortunately many of the new fields discovered do not even repay the operator his initial exploration and development costs—let alone a reasonable profit taken for granted in other industries.

"There are numerous aspects of the oil business *Time* might have mentioned but if it had the story would not have the reader appeal needed to maintain circulation. In reality, the facts would make your readers wonder why anyone stays in such a tough racket. Probably it is because we all hope to be another Murchison even though we know the odds are a million to one."

MARK OLSON, Petroleum Consulting Services.
Rio Grande City, Texas

(For more data on advertised products, use Readers' Service blue cards, last page this issue.)

Looking Ahead . . .

. . . **New airborne radar** system would be of untold benefit to petroleum industry in general and offshore operations in particular. Demonstrated by Bendix Aviation Corporation, the system shows pilot a closeup of storms 150 miles away. Radar picture is so detailed that storms are outlined clearly, allowing the pilot to avoid worst areas. Set weighs only 130 pounds, is small enough for a two-engine executive plane.

. . . **Supply of technical graduates** will not catch up with demand until 1960, some colleges say. Reason for squeeze is twofold: low birth rate of the 1930's and continuing demand of Armed Forces. Engineering Manpower Commission says men trained in science make up nearly 3 percent of today's Service complement, although they comprise a scant 1 percent of nation's labor force.

. . . **Future development** will prove that the federal government got all the best of the division of the Texas-Louisiana Continental Shelf Lands. Ben C. Belt, vice president of production for the Houston division of Gulf Oil Corporation, told a group of oil writers that "the best informed geologists believe that the effect of the law was to allocate 85 percent of the valuable prospective land on the Continental Shelf to the federal government."

. . . **Oil will invest approximately $400 million in Canada** during 1954, by some estimates. Investment last year was at a rate of approximately $1 million a day.

. . . **Atomic energy can't soon compete** with oil in powering automobiles, trucks, buses, airplanes, railroad engines or home heating. This is opinion of M. J. Rathbone, president of Standard Oil Company (N. J.), who believes atomic energy will eventually compete with coal, oil and gas in generation of electric energy in large central power plants. However, he pointed out that in 1953 less than 3 percent of the oil consumed in U. S. was used in generation of electric power by utility companies. This figure will mount considerably, according to electrical authorities. Experts in this industry say average family's investment in electric appliances, now $1300, will soar to $5000 in next decade.

. . . **Construction expenditures this year will reach $36 billion,** Commerce and Labor departments say. This would be 2 percent above 1953's high. In November the two agencies first guessed 1954 expenditures at $34 billion. Commerce also predicted that business outlays for new plants and equipment in the second and third quarters will drop only slightly from first quarter rate of $27.5 billion a year. Total for year will probably reach $27.2 billion as against 1953's record $28.4 billion.

. . . **Canadian oil men** hope to get a percentage depletion allowance patterned after the U. S. version. Present Canadian allowance of 33½ percent is calculated on net income, whereas U. S. allowance of 27½ percent is based on gross income.

. . . **Internal Revenue expects to step up auditing** of personal tax forms to bring extra revenue more nearly on a par with last year. Revenues unearthed an additional $1 billion through March 31, about 8.5 percent less than year before. Officials blame drop on fact they have been auditing fewer personal tax forms.

. . . **Smog-sniffers may be used** in Los Angeles' continuing fight to determine cause of nuisance. Industry-supported foundation, in cooperation with county air pollution control district, offered to establish analyzer-recorders 24 hours daily for four months beginning July 15.

. . . **World's biggest tanker will be used** to ship Saudi Arabian oil to European markets. The $6 million ship was built at Hamburg, Germany, for Aristotle Socrates Onassis, Greek shipping tycoon who made a deal with King Saud to transport about 10 percent of country's oil in his tankers. World shippers have protested the arrangement will eventually give Onassis a monopoly in carrying Arabian oil.

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Dowell engineers perform Retarded Acid treatments in the same way as conventional acidizing, using the latest treating techniques, modern tools and high-pressure, high-volume pumping equipment.

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(For more data on advertised products, use Readers' Service blue cards, last page this issue.)

Better Press Relations Needed

A better job of winning friends and influencing people must be done by oil companies. This is the chief means of offsetting attempts to regulate or otherwise unjustly hamper the industry's operations.

Attacks on the industry continue to occur entirely too frequently. While these attacks come in various forms, all have one thing in common. Each is based on a lack of understanding of the industry's operations.

Too many people think everyone connected with the oil business is a millionaire. Too many believe much of the wealth accumulated by the fortunate few who strike it rich is the result of special tax favors resulting from the 27½ percent depletion allowance.

Too few realize the hazardous nature of the industry, the great amount of capital involved, or the odds against striking it rich. Too few appreciate the vast amount of taxes paid by the industry.

•

The general press of the nation seems entirely too quick to publicize these attacks and utterances against the industry. This is most unfortunate, as the press is the best bridge between industry and the voting public. The press gives the public most of the information it receives. Therefore, it is vitally important that there be a better understanding of the industry's problems and operations among newspapermen.

This can best be accomplished by telling newspapermen the facts about the industry in plain language. The education of the general press is a vital key to seeing that the public is properly informed with the truth rather than misinformation.

For the most part, newspapermen in oil regions are friendly toward the industry. This is because they know and appreciate the industry. However, there exists a much larger group in other regions who have not had this opportunity. They seldom get a chance to come in contact with the industry's operations. Unfortunately, a great majority of these men represent publications with huge circulations in the more heavily populated sectors of the nations.

The latter group of newspapermen need to be provided with opportunities to see for themselves how the industry works. The industry has done more along these lines in recent years than in all past history. But still much more needs to be done.

•

A fine example of getting a part of the oil industry's message to the public and particularly to newspapermen took place last month. Gulf Oil Corporation used the formal unveiling of a new offshore drilling tender to show approximately 100 writers from 60 publications with a combined circulation of several million people some things about offshore activities.

The company was host to the group at Corpus Christi. Many of the newspapermen were getting their first glimpse of offshore oil activity. They saw the massive size of what it takes to drill a well offshore.

Ben C. Belt, Gulf vice president, gave the writers some plain talk on just how expensive this undertaking can be. (Therefore, how important and necessary the depletion allowance becomes.)

Among other things, Belt told newspapermen that the cheapest 10,000-foot offshore well probably would cost $1 million, and that before starting an offshore well an expenditure of $3½ million is necessary for a platform, drilling rig and tender. Belt was assisted by an array of Gulf operating men capable of answering all questions on every phase imaginable.

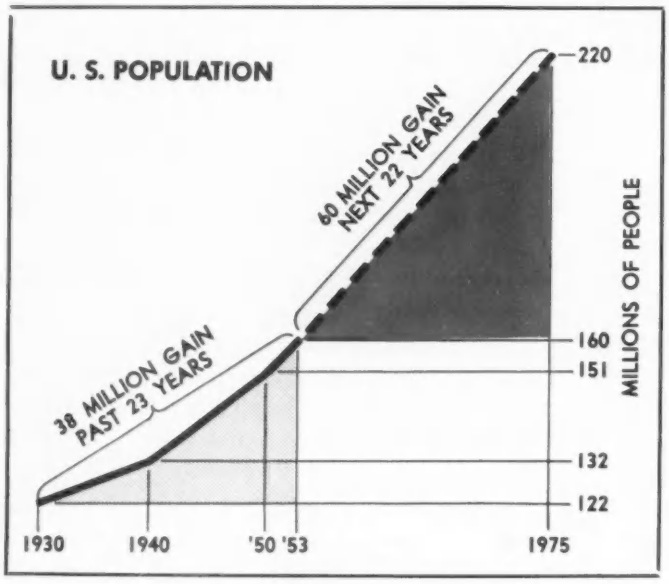
These facts may be considered to have been delivered to several million readers. The facts will stay in the minds of the newspapermen forever. No one can measure how much good may eventually come from this operation. The affair cost Gulf several thousand dollars, but it was cheap at twice the price.

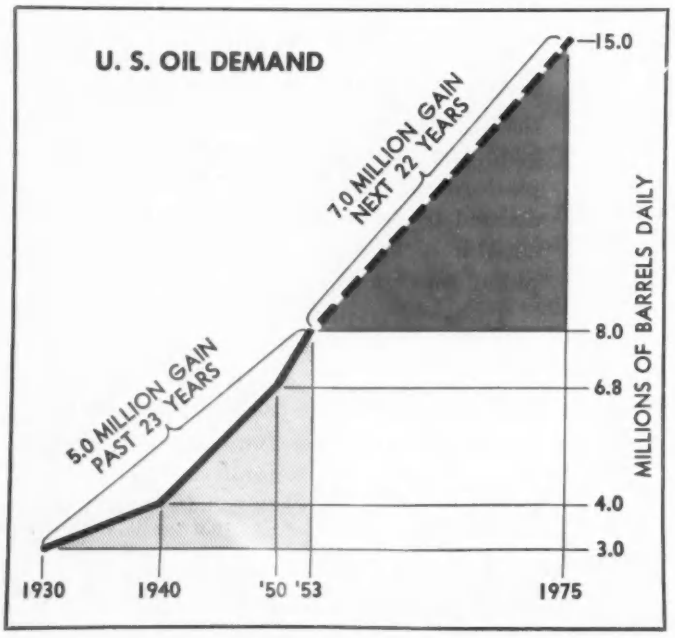
Warren L. Baker

Higher Oil and Gas Producing

- Industry must keep pace with tremendous population growth.
- Higher consumption to require more oil and gas production.

By **WARREN L. BAKER,** Editor, World Oil





Population of the United States is really going places by 1975. And the petroleum industry is going with it. Oil consuming rates will undergo a tremendous growth. Much larger consumption will require higher U. S. oil production in future years, despite increased foreign imports. Natural gas production will show an especially large gain.

To provide sufficient producing ability to satisfy skyrocketing consumption, it will be necessary for much greater volumes of oil and gas to be found in the future than has been required in the past. This situation will create a need for more exploratory work, expanding drilling activity and higher producing operations.

U. S. Population Boom . . .

Future U. S. population growth will be almost twice as fast as in the past. The U. S. Census Bureau has predicted that population of the country will reach 220 million by 1975, an increase of 60 million people in the next 22 years. During the preceding 23 years, U. S. population jumped from 122 to 160 million, a growth of only 38 million consumers.

People determine market volumes for everything. Therefore, it looks like business markets in the U. S. will experience a tremendous expansion by 1975. More of everything will be needed as population increases in future years—more food, clothing, homes, automobiles, etc. This also means more oil and gas will be consumed.

Larger Growth in Oil Consumption . . .

Faster future population growth means U. S. oil consumption will increase sharply. U. S. oil demand likely will reach 15 million barrels daily by 1975, compared with 8 million in 1953. This would be a gain of 7 million barrels in daily consumption during the next 22 years, in contrast with a growth of only 5 million between 1930 and 1953.

To reach the predicted level of 15 million barrels daily by 1975, future consumption will need to increase by the conservative average of slightly less than 3 percent per annum over the next 22 years, or just over 300,000 barrels a year. Postwar growth has been above this rate of increase, so 15 million barrels per day does not seem an unreasonable forecast for 1975.

Rates Lie Ahead of the U. S.

- Increased production means huge discovery task in future.
- Expanded drilling will be needed to find enough new supply.

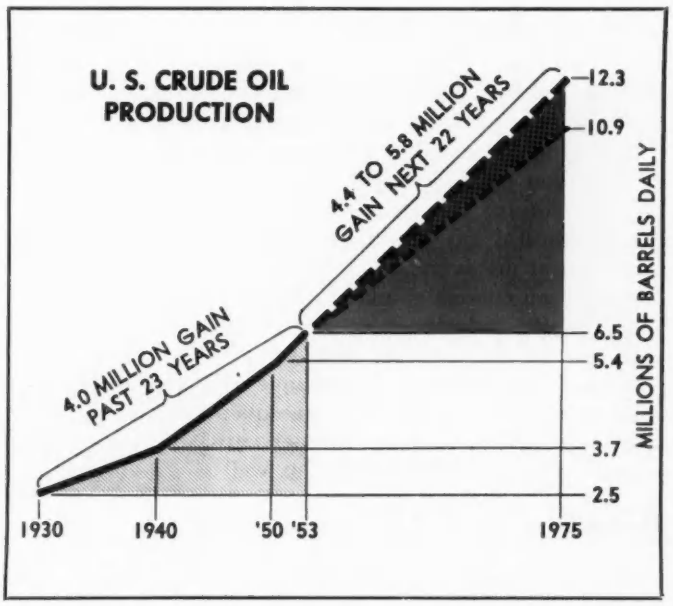
More Oil Production Needed . . .

Growing demand will require greater U. S. crude oil production. Despite prospects that imports of foreign oils and domestic natural gasoline will continue to expand in the future, the U. S. will need to produce much more crude oil in the years ahead.

Forecasting future import volumes is difficult. There are many different opinions. However, some idea of what lies ahead for U. S. producers can be gleaned by taking two extreme viewpoints.

Even if imports in 1975 are 3 million barrels daily, three times more than in 1953, and domestic natural gasoline output has attained a volume of 1 million barrels per day, 50 percent larger than last year, the U. S. will still need to produce something like 10.9 million barrels of crude oil per day in 1975 to satisfy estimated demand. Should imports reach only 1.8 million barrels per day (75 percent above last year) and natural gasoline output be but one-third larger, the U. S. would need to produce 12.3 million barrels a day in 1975 to satisfy consuming requirements.

Whether U. S. crude production in 1975 is 10.9 million barrels or 12.3 million barrels per day, a higher rate of growth will be required in the future than in the past. Growth during the next 22 years on this basis would be 4.4 to 5.8 million barrels in contrast with a 4 million barrel gain during the previous 23 years.



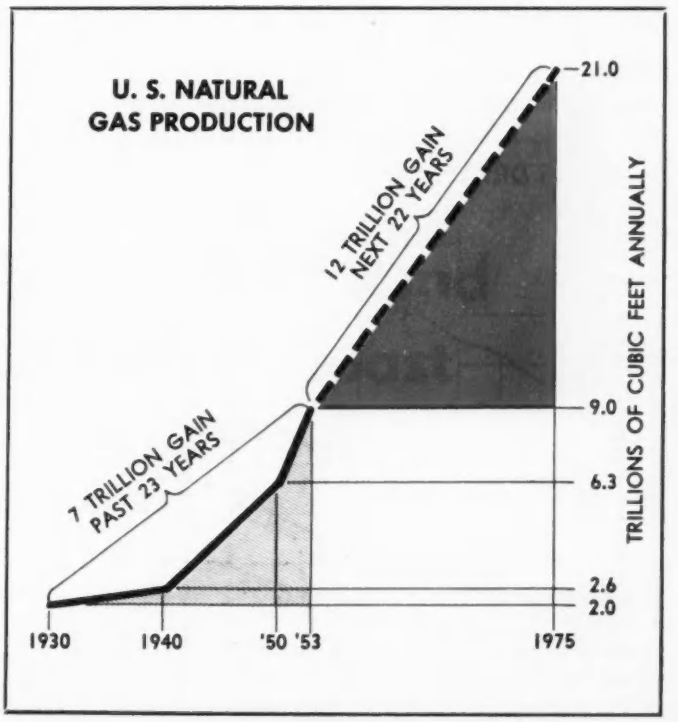
Much More Natural Gas Also . . .

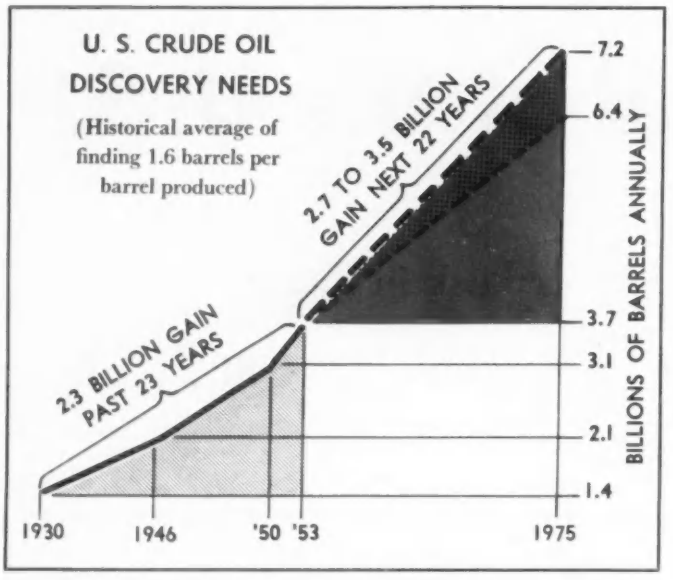
Far more natural gas also will be consumed in the U. S. in the future. In addition to the effect of population growth, many industries and homes are converting to gas from other fuels.

While the day of racing for a franchise area or of taking a dump load under a boiler are largely gone, the gas industry is going to grow in scope. Gas will enter the home heating and high-grade industrial fields on a greatly expanded scale. Heavily populated and highly industrialized areas which have not been supplied with gas for any length of time offer tremendous expansion possibilities.

Several sources have estimated 2½ times as much natural gas must be produced by 1975 as in 1953. This is a conservative estimate the way marketed gas production has been growing in recent years.

This would mean annual U. S. natural gas marketed production of at least 21 trillion cubic feet in 1975,





compared with 9 trillion cubic feet at present. Whereas, natural gas production rose 7 trillion cubic feet in the preceding 23 years, this forecast anticipates a rise of 12 trillion cubic feet will occur in the next 22 years.

Heretofore, the industry has not concerned itself with natural gas producing needs. The more or less incidental discovery of gas while seeking oil has made more than enough available to meet requirements.

Now the industry must also begin to think in terms of natural gas requirements. Larger quantities of gas must be found to supply the huge amounts likely to be consumed in the future. Consequently, the industry henceforth will need to consider natural gas discovery and producing requirements, as well as those of oil.

Huge Discovery Task Lies Ahead . . .

Sharp expansion of producing rates will make it necessary for the U. S. to find larger and larger quantities of new oil and gas as the years pass.

Historical experience of the industry shows that 1.6 barrels of new oil normally have been found for every barrel produced. This rate is required to maintain the nation's customary relationship between producing rates and proved unproduced reserves. On this basis the industry needed to discover less than 1½ billion barrels during 1930, and only slightly over 2 billion barrels in 1940. Rising production, however, boosted discovery requirements to 3¾ billion barrels in 1953, up 75 percent from late prewar needs.

Future discovery requirements will soon climb to 4 billion barrels annually, and by 1975 will approximate 7¼ billion barrels if yearly production reaches 4½ billion barrels (12.3 million daily); or 6.4 billion barrels if domestic crude production is 4 billion barrels annually (10.9 million daily) in 1975. Such large discovery rates never have been maintained in the past, so the job ahead is much greater than ever before.

Higher Drilling Rates Needed . . .

It is highly significant that U. S. oil finding rates have been expanded sufficiently to keep abreast of growing production needs. The existence of more new oil has been proved in the last five years than in any previous similar period of time.

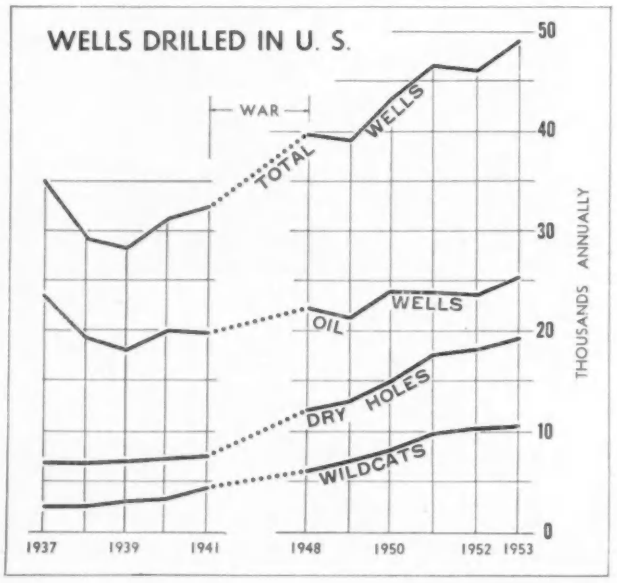
Discovery of record volumes of new oil has been the result of a greatly accelerated exploration and drilling effort. The immensity of future discovery requirements will necessitate further expansion of these activities in coming years.

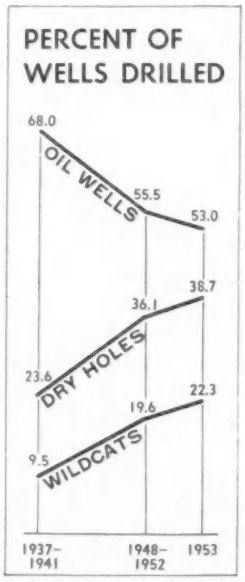
More than 49,000 wells were completed in the U. S. during 1953. Fifty thousand wells likely will be completed in 1954. These volumes contrast with the prewar peak of 35,000 wells in 1937.

In its vigorous search, wildcat drilling last year was double that of 1948 and three times larger than in any previous year. Wildcats now account for nearly one-fourth of all wells. Before the war, they represented but 10 percent of the wells.

Increased wildcatting has boosted the number of dry holes drilled to 18,500 in 1953. This was 2½ times greater than the prewar average of less than 7000 failures per year. Nearly 40 percent of all completions in late years have been dry, while only one-fourth were failures before the war.

These same drilling trends are likely to be continued in the future. More total wells will be needed, with a larger portion of them wildcats and dry holes.





Where Is Future Supply Coming From? . . .

The success of expanded exploration and drilling operations in recent years indicates further expansion of these activities can provide the huge quantities of oil which will be needed in the years ahead.

This raises the question of where the U. S. will find its oil supplies for the future. This is the subject of a symposium starting on the following page.

Where Will Future U. S. Oil And Gas Supplies Come From?

To find sufficient supply to satisfy greatly expanded future oil and gas consuming rates confronts the U. S. with an enormous problem. To obtain the best thinking on this vital subject, WORLD OIL invited several leading geologists to discuss the outlook for different areas.

WHERE WILL sufficient oil and gas be found to supply the growing population of the U. S. 20 years from now? Of course, nobody knows exactly where all the oil of the future will be discovered. However, well-informed geologists can pretty well tell what general areas offer the best discovery possibilities.

While imports no doubt will be much larger 20 years hence, the U. S. will still need to produce far more crude to satisfy greatly increased consumption. (See article Page 58.) At the same time, various estimates have predicted that natural gas consumption in 1975 will be 2½ times larger than in 1953. The ability to import gas will be far more restricted, so the future gas supply is going to have to be developed within the U. S. or Canada.

To obtain opinions on the question in the first paragraph, WORLD OIL and PIPE LINE INDUSTRY asked a group of outstanding geologists to help select geologists qualified to speak authoritatively on various regions of the U. S. and Canada.

How this article was developed

These men were requested to participate in the accompanying symposium by commenting on the following questions:

- What is the outlook for future discovery of oil and gas in your district?
- Have most of the favorable oil and gas areas in your district already been developed, or are there important and sizable territories still undeveloped?
- Are geological conditions and prospective undeveloped territory such that discoveries of oil and gas are likely to be larger, the same, or less than volumes found in recent years? In other words, do you think the rate of finding new oil and gas reserves can be increased?
- What particular areas in your district offer the best possibilities for finding large volumes of oil and gas?

More Oil Can Be Found Along the West Coast

By GRAHAM B. MOODY, Chief Geologist, Standard Oil Company of California

THE WEST COAST'S economically important petroleum discoveries have been confined to California which certainly will enjoy future similar discoveries. Oregon and Washington probably will find petroleum in sufficient quantities for economic exploitation.

Some observers say that California has been explored so thoroughly that little, if any, favorable territory remains for testing. Such prematurely ossified thinking has been prominent during past decades in published comments on California's future oil prospects. Fortunately for the industry, there have been always enough optimists among California's efficient exploratory men and oper-

ators who have found petroleum in paying quantities where the pessimists said there was none.

Some significant oil showings and non-economic gas pools are the only rewards for intermittent exploratory effort in Oregon and Washington. These are, however, provocative indications of future possibilities.

Any region underlain by sufficient thickness of sediments ordinarily present in oil-producing basins must be considered as favorable for prospecting until the density of unsuccessful exploratory drilling is such that the region is definitely disproved for production. Density of drilling in Western Oregon and Western Washington has been one hole to 66 and 298 square miles, respectively.[1] Much of the wildcatting has had a distinctly promotional flavor, hence is not significant in appraising petroleum possibilities. Great sedimentary areas in Oregon and Washington are unexplored by drilling; these are favorable for possible discovery.

An extremely fine-toothed exploratory comb has traversed California's sedimentary areas. Density of exploratory drilling of one well to 1.1 square miles[2] in the Los Angeles Basin, for example, suggests rather complete testing of that region's possibilities. Exploratory holes are not evenly distributed, however; parts of the basin may have only one hole to 5 or 10 square miles. An important oil field may hide in a couple of undrilled square miles. Productive possibilities are viewed more realistically as three-dimensional anyway. Favorable petroleum regions probably are resting undisturbed beneath presently producing areas. These considerations justify the conclusion that California still has undeveloped favorable petroleum areas.

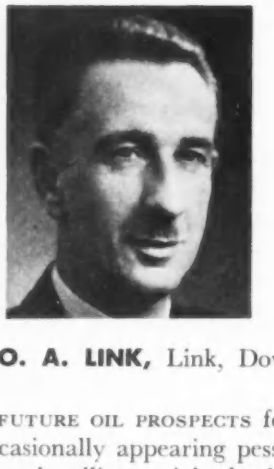
Any future discovery of economically producible petroleum in Oregon or Washington will be larger, of course, than anything found in those two states to date. California's recent discovery record is so undistinguished that it should, perforce, improve in the future. Despite the fact that California's three-year average annual discovery curve shows only two half-hearted upward bulges (1942 and 1948) since the last significant high in 1937 and has declined steadily since 1948, there are definite indications that the discovery rate will increase in the near future.

The West Coast's most likely possibilities for discovery in substantial volume include: California—offshore fields, large blocks of sediments below thrust faults, new pools adjacent to or underlying currently producing fields, geological formations and provinces that have produced little or no petroleum; Oregon and Washington—areas of exposed sedimentary rocks and blocks of sediments covered by lava flows.

Future discovery of large volumes of petroleum on the West Coast will depend on astute analysis of all factors involved in an exploratory program, unlimited courage to implement that program, and expenditure of large sums of money; a bit of luck may be the final ingredient that will determine the success of an exploratory venture or of an operator.

REFERENCES

[1] Possible Future Oil Provinces, *Bulletin AAPG*, Volume 35, No. 2 (Feb. 1951).
[2] Ibid.



Canada Can Expect More Discoveries in Future

By THEO. A. LINK, Link, Downing & Cooke, Ltd.

THE FUTURE OIL PROSPECTS for Canada are not what some occasionally appearing pessimistic "Blue Monday" newspaper headlines might lead us to believe, nor will new discoveries be made as easily as one might think after reading a high-pressure sales promotion leaflet for a newly organized oil company. Somewhere between these two extremes lies the answer to the question "What about the future oil and gas prospects of Canada now that Leduc, Redwater and Pembina have been discovered?"

Before Leduc was discovered the writer of this article "went out on a limb" and suggested that Western Canada should be good for 1½ to 2 billion barrels of oil if a certain number of exploratory holes were drilled. Since that amount of reserves and more has already been established, because sufficient holes were drilled, one should be able to make another guess, and a better one at that, because more data are now available. Likewise, at the first natural gas hearing in 1948, when the then known gas reserves were less than three trillion cubic feet, it was suggested that 10 trillion cubic feet would be found within five years. There are now more than 12 trillion cubic feet established.

The discovered oil reserves in Canada prior to Leduc (1947) were, compared to the present reserves, an almost negligible amount, but since then appreciable reserves have been added each year; large amounts some years, lesser amounts during other years. On the basis of the graph showing these cumulative increases it is quite obvious that a similar theory should work to predict future prospects namely, that the discoveries will be closely related to the number of exploratory holes drilled, plus the increase in efficiency in logging wildcat wells, plus refinements in and new geophysical prospecting devices, as well as revised or new geological thinking as additional data become available, and other improvements in both exploratory and production methods.

Optimistic view. In view of the above it is not deemed necessary to look outside the great Western Interior plains area of Alberta, Saskatchewan, British Columbia, Manitoba and Northwest territories to feel optimistic about Canada's future reserves. One should also consider the other sedimentary basin areas such as the Vancouver Island coastal basin, the James Bay portion of Hudson's Bay, Southwestern Ontario, St. Lawrence Lowlands, Gaspe, and the Maritime Provinces, but none of these appear promising enough to consider them in the same breath as the basin area of the prairie provinces.

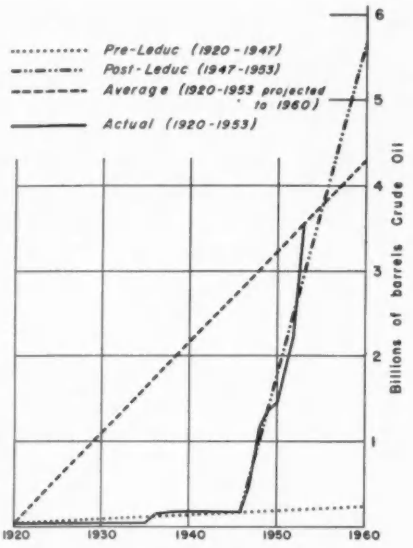


Fig. 1—Rate of cumulative discoveries.

Nevertheless, more oil and gas reserves from these other basins will be added to Canada's total. Likewise, if, as, and when Canada's oil reserves have been depleted and others made unavailable to such an extent that the price per barrel is so high that mining and extraction of oil from the tar sands of the Athabaska in Alberta is a profitable proposition, these reserves will then come into their own, and naturally add a tremendous amount to Canada's future oil reserves. Until that takes place the tar sands oil cannot justifiably be classed in the category of "proven undeveloped oil reserves."

Returning now to the Great Plains area of the west, and a look into their future, one cannot help but notice a similarity between "guestimating" the oil reserves of a newly discovered field or pool after completion of the discovery well. The first guesses are invariably too high. After several holes, with some reasonably long stepouts have been completed, the scientific estimates begin on the basis of the volumetric method which involves porosity, permeability, thickness of pay, areal extent of the field and the dangerous "percentage of recovery" factor. Here again the estimates are still on the optimistic side, and remain so until a greater number of holes have been drilled which includes some which are just plain failures, and others "not so good." At this stage the self-styled "conservative" estimators step forth, and slash the reserve estimates to an alarmingly low figure.

Preliminary and apparently alarming pressure decline data usually add fuel to their fire of pessimism. Prices for proven acreage are supposed to drop—and usually do, so that there is a change of ownership on a large scale in the field in question. However, as time goes on and the field or pool is drilled up, other pay horizons are quite often found, the field begins to extend a little more here and there with new stop-outs, etc., production decline curves become more reliable, the initial pressure decline is arrested, and it is generally conceded that although the first optimistic figures were too high, the first computations, based upon scientific reservoir data, were also too low.

This same sort of history applies to national and world petroleum and natural gas reserve figures. When oil was first discovered in large amounts in the U. S. no one dreamed that such oil and gas reserves were expendable, and it was generally understood that the country would always have a plenty. However, some 30 to 40 years ago a group of experts began calculating the oil reserves for the U. S. and came up with a figure of seven years' supply left in the ground. That was quite a shock, and oil geologists then came into their own. (Not as reserve estimators, but for oil exploration.) More oil had to be found. It was found, but every once in a while there was over-production and there resulted a slack in exploratory effort. After each slack period of exploration the reserves graph showed a decided lowering in rate of climb. Now the attitude is that the reserves are not inexhaustible, they are not alarmingly inadequate, but that for some time to come they will suffice if the necessary effort to look for more oil and gas is put forth.

Prospects good. In view of the fact that the number of exploratory holes drilled per acre in the Western Canada sedimentary basin area is far below that in the U. S., it's reasonable to believe that this Canadian area has better prospects for more discoveries in the future. Certainly the Canadian discovery rate of the last seven years will not be maintained uninterruptedly, but it ought to be somewhere between the pre-Leduc and the post-Leduc rate. The same applies to the natural gas reserves. Such being the case, the undersigned sees no need of considering all the sedimentary basin areas in Canada nor the tar sands oil, in order to feel optimistic about Canada's future oil and gas reserves.

The Western Interior basin area is large enough and results obtained to date warrant a geat deal more exploratory effort, and this should result in an increase of oil and gas reserves sufficient to "keep the wolf from the door" for some time to come. If the discovery rate for a period of 1 or 2, or even 3 years, does not measure up to the results of the best one of the last seven years there is no need for alarm, such as one occasionally reads in newspapers, when for an example, the discovery rate for January of 1953 was not as good as that of January, 1952 or 1947. Such comparisons are usually propaganda

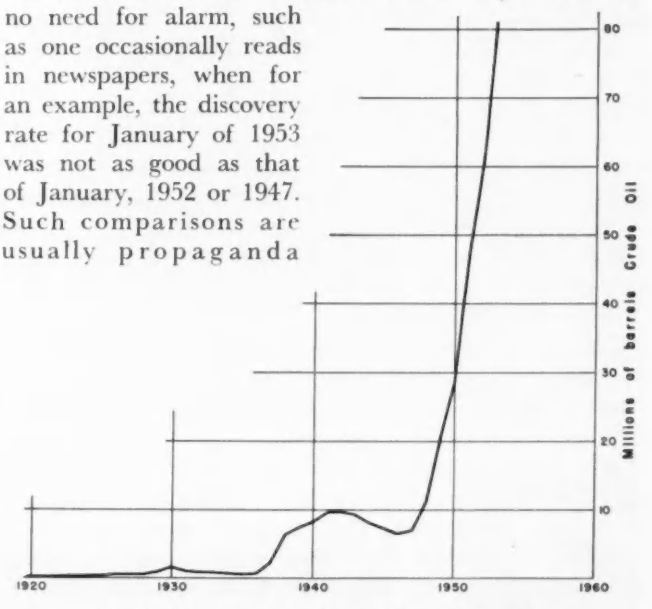


Fig. 2—Yearly production of Western Canada.

and very misleading, and the same applies to the same method if applied for extreme optimistic purposes.

To summarize, it appears that oil and gas reserves to be discovered in the future within the Dominion of Canada are such that the country will soon produce enough to meet all of its own requirements, and that a considerable amount will be available for export for some time to come. As a comparison one might say that the oil industry in Western Canada is at a stage comparable to that of the U. S. some 20 years ago, and that the resulting industrial expansion related to petroleum and natural gas reserves should be comparable. A conservative projection of the graph showing cumulative production of oil indicates that a minimum of approximately 4 billion barrels of oil should be discovered by 1960 in the Interior Plains area, and on a similar basis a minimum of 17 trillion cubic feet of gas should have been discovered by that time. In all probability, a great deal more will actually be found by 1960, and eventually the oil reserves will be in tens of billions barrels and corresponding gas reserves in multiples of tens of trillions cubic feet.

Added Oil From the Lower Mid-Continent, Gulf Coast

By ED. W. OWEN, Geologist, L. H. Wentz, Oil Division

THE LOWER MID-CONTINENT and Gulf Coast districts, comprising Southeast New Mexico, Texas, South Arkansas, Louisiana, Mississippi, Alabama, and Florida, contain 69 percent of the nation's proved oil reserves and furnish 61 percent of current production. Present productive capacity exceeds allowable production in several major fields and should continue to do so for the next few years. Since reserves and productive capacity are still increasing consistently, this prolific area should contribute a large part of the United States total supply for many years. However, limitations to the ultimate amount are becoming apparent.

The following considerations are fundamental to a discussion of future prospects.

- A major part of the total oil finding effort of the U. S. has been concentrated in this area for many years. Almost every square mile has been covered several times by the various geological and geophysical techniques.
- Capital and equipment have been available for drilling most prospects almost as soon as found. Many operators now hold fewer known undrilled prospects than they have had for many years.
- Economic conditions since World War II have favored the drilling of wells, which in earlier years would have been unprofitable. The resulting development rate has been faster than the discovery rate, leaving progressively fewer undrilled proven locations.
- Wells on many of the favorable structures have been drilled to the deepest prospective horizons or to present practicable drilling depths.

Offsetting these discouraging features are certain favorable factors.

- The enormous indicated potentiality of the continental shelf is relatively untouched.
- A great new store of geological information has been made available by new logging methods and improved drilling practices in the thousands of recent deep wells. This has cumulative possibilities greater than any other discovery factor since the introduction of the seismograph.
- New concepts of oil accumulation and occurrence increased the scope of exploratory efforts.
- Improved engineering practices, especially in pressure maintenance and secondary recovery, afford greater ultimate yields from both new and old fields.
- Increased utilization of natural gas liquids and more efficient processing add large reserves which were formerly neglected.

The geologist's ideas of future enterprises are unrealistic unless expressed in concrete terms. The writer, therefore, ventures to put a quantitative tag on his guesses regarding possible future sources of oil. These quantities, expressed in billions of barrels of ultimate recovery, are presented only as his personal opinion of the general order of magnitude for each of the categories under examination. They have no relationship to any official forecasts which have been made by industry committees or governmental agencies. Without other excuses, he postulates a lower-upper range, as follows:

1. Begin with the only solid figure in the whole lot—the proven reserves as of January 1, 1954..... **24 billion**

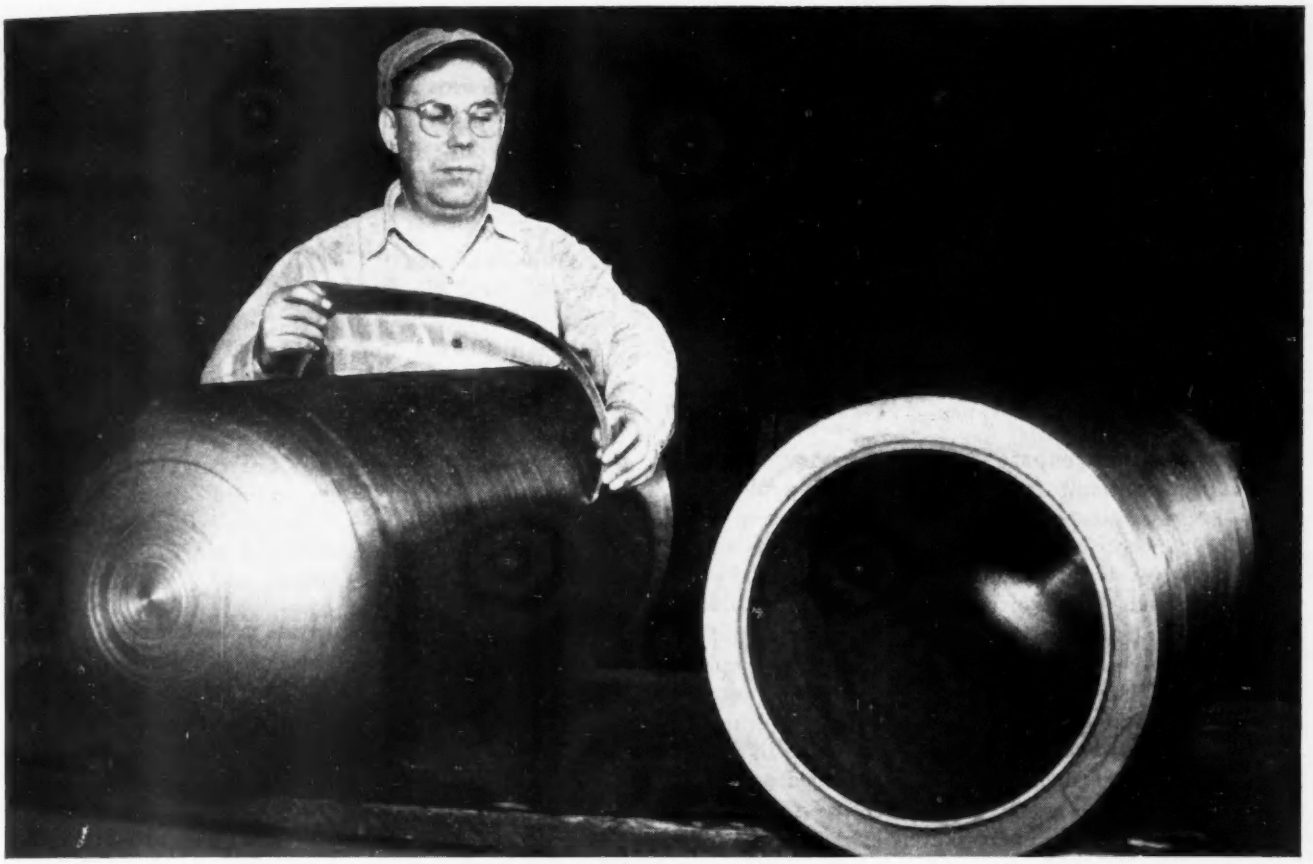
2. Future revision of reserve estimates of present fields in the light of further development will add ..... **3-5 billion**

3. Gulf Continental Shelf: Costly operations here will be highly sensitive to economic conditions. Under favorable circumstances, add..... **5-10 billion**

4. Deeper drilling on present producing structures: Although deep drilling has been general throughout the area, many large structures have been inadequately tested at depth. In West Texas and New Mexico, lower Permian and Pre-Permian beds are still partly, or wholly, unexplored on several important structures.

Recent discovery of flush Cambrian production in West Central Texas will introduce an active exploratory campaign, and some new oil will be found. It is not yet known whether this oil accumulated as a result of unusual local conditions, or whether Cambrian oil may be rather general.

Potentiality of pre-Edwards Lower Cretaceous and Jurassic formations in the Fault Zone is practically un-



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known, although the few deep tests have been discouraging. New discoveries in these formations continue to be made in East Texas, North Louisiana, South Arkansas and Mississippi, and add modest amounts to existing reserves.

In the Gulf Coast provinces, deeper drilling activities are limited only by lack of known objective horizons having tangible economic promise. With thousands of feet of sedimentary section remaining unexplored, it is inconceivable that discoveries will not be made at greater depths in many of the present fields.

Taking everything into consideration, it seems reasonable to assign to future deeper discoveries on present known structures a value of.....**4-8 billion**

5. Stratigraphic Traps: "Stratigraphic trap" oil has always been difficult to find by planned exploration, partly because prospecting programs have been based firmly on concepts of local structure. Most discoveries of this type have resulted indirectly from structural prospecting or from haphazard wildcatting. Our realization that oil is a much more common constituent of sedimentary rocks than we used to believe, will intensify exploration for stratigraphic traps. We are only beginning to have really effective tools for the search, the high quality logs of thousands of recent wells which enable individual members of the geologic column to be traced accurately over wide areas. Regional and intensive stratigraphic studies should examine every porous zone to its permeability boundaries.

The truncated or depositional edges of many formations on the sides of the Central Basin Platform, Concho Arch, Matador Arch, and all other major positive features have vast potentialities. Many reef areas are only partially explored. The updip edges of many sands along the flanks of the Delaware and Midland Basins and major segments of the Gulf Embayment must be considered as possibilities.

These abundant stratigraphic traps will probably be our greatest source of future discoveries. Assume a widely ranging value of.....**5-15 billion**

6. New Structures: Undeveloped deep parts of our major basins undoubtedly have important local structures which we have not been able to work satisfactorily. Many other areas have been characterized by poor seismograph records and a paucity of other structural information. Improved geophysical techniques and more effective collaboration between geologists and geophysicists can be expected to uncover many favorable prospects. Let's give them.....**3-6 billion**

7. New Provinces: The Big Bend area of Texas, large parts of the "Rio Grande Embayment," coastal Mississippi, the "Florida Parishes" of Louisiana, and all of Alabama and Florida are still relatively untested. Some oil is there and more should be. We'll guess about.**2-4 billion**

8. Extraction of natural gas liquids has increased phenomenally in recent years, but some substantial sources of gas are not yet being utilized. Gas-distillate fields should constitute a very important part of future discoveries. From non-oil-associated gas, not included in reserve figures or in the guesses above, add.....**3-5 billion**

9. Ten percent of our gross production is from stripper and marginal wells, and thousands of new small wells are being drilled each year. Reserve estimates are based on the past experience record of early abandonment of such production. If improved economic conditions of the industry, the depletion allowance, and the availability of pipe can be maintained consistently, the supply of stripper and secondary recovery oil will be greatly increased. Add a hopeful.....**2-4 billion**

Summary: The minimum speculative increment exceeds the total proved reserves, which are slightly greater than the cumulative production to date. The combined proved and postulated supply under the lower guess would equal 32 years production at the 1953 rate, or 50 years at the higher estimate. It is believed that the higher figure is attainable only under consistently favorable economic conditions which stimulate energetic exploration.

Gas supplies should follow a similar discovery pattern, but are harder to appraise, due to wide variations in price, working pressures, and utilization practices. Lack of sound historical statistics on actual supply precludes realistic estimates of the future.

Discovery Prospects Good In Rocky Mountain Area

By CHARLES W. STERNBERG, Consulting Geologist, Denver

THE ROCKY MOUNTAIN province is an attractive area for discovery of future oil and gas reserves. The region covers more than 750,000 square miles, and embraces Colorado, Idaho, Montana, Western Nebraska, Northern New Mexico, North Dakota, South Dakota, Utah, and Wyoming. Arizona and Nevada, which are frequently considered to be part of the Rocky Mountain Province, are not discussed here.

The region is the largest single area in this country where presently known techniques will realize the possibilities for large future reserves. Throughout the Rocky Mountain states, there have been fewer wells drilled than in the East Texas field. New discoveries in the past few years have indicated enormous potentialities. Exploration, production, transportation, refining, and consumption have increased markedly, and will continue to do so

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- Its operating parts are few and simple.
- Built-in packing assures full circulation.
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in the future. A greatly expanded level of exploratory activity is a most promising development.

The region has produced oil since 1862, when the first discovery was made at Canon City, Colo. In Wyoming, the Dallas field was discovered in 1883; it also is still producing oil. Little is known concerning early oil developments in Montana, but production was established by 1916. The earliest oil production in Northern New Mexico was obtained in 1922 in the Hogback field.

Utah discovery. Utah had its first real commercial discovery in 1948, and Western Nebraska in 1949. The Dakotas had previously produced some gas, and during 1951, North Dakota became an oil-producing state when oil was discovered on the Nesson Anticline. South Dakota became the twenty-eighth oil-producing state early in 1954. As yet there has been no production in the state of Idaho.

In spite of this long history of production, the Rocky Mountain Province has been relatively neglected. The reason for this is chiefly that the oil could not always successfully compete with crude produced in other parts of the country. The local market has been a limited one. There is, however, a trend of population westward, and this trend is expected to increase. Oils in the region range in gravity from 75° to 11° and vary in color from clear to black. Some have pour points higher than 90° F., others are still liquid at —50° F. The sulfur content varies from a trace to more than four percent. Both oil and gas reserves are known throughout the province.

In the Uinta Basin, many asphaltic substances such as gilsonite, ozokerite, and wurtzilite are found, and there is enormous tonnage of oil saturated sandstones in this basin. The oil shales are an important future factor in the petroleum industry, and the Green River formation of Eocene age is the chief source of oil from shale. Proved reserves are stated to be in excess of 60 billion barrels. Carbon dioxide and helium occur at many places throughout the region.

Drilling depths range from a few hundred to thousands of feet. The West Poison Spider field produces from a depth of 14,400 feet, and for a time, was the deepest producing field in the world.

On the West the Rocky Mountain area lies in the great Cordilleran Geosyncline and more particularly in an eastern area of subsidence, the Rocky Mountain trough. This trough received enormous thicknesses of sandstones, shales and limestones, which are not metamorphosed. A general boundary may be drawn along the North-South zones of faulting which define the eastern limit of the Basin and Range province. The rest of the Rocky Mountain region is a shelf area between the Canadian Shield and other positive features and the Cordilleran Geosyncline. These shelf areas received thin deposits of sediments from widespread shallow seas. Various tectonic events—for example the Ancestral Rockies—influenced and modified this pattern.

Oil seeps occur in outcrops of pre-Cambrian rocks in widely separated localities. The Cambrian and the Ordovician produce oil. Silurian beds are missing in parts of the Rocky Mountain area, but are present and productive in the Williston Basin. The Devonian produces in the Williston Basin, and it is a future objective in other parts of the Rocky Mountain province.

The Madison limestone (of Mississippian age) is the oldest proved commercial zone in much of the area, and the Big Snowy group, which is also Mississippian, while limited in distribution, is a worthwhile objective. Most of the Pennsylvanian oil comes from the Tensleep, and its equivalents, the Weber and the Minnelusa. The Embar is a producing formation in Wyoming, the Lyons sand produces in the Denver-Cheyenne Basin, and the Coconino sandstone, which is also Permian in age, produces in southeastern Utah.

Triassic beds produce in Wyoming and in Colorado. The Ellis and the Sundance which are middle Jurassic in age, produce large amounts of oil and constitute a first-class objective over much of the territory. Cretaceous sandstones are the most widespread oil and gas zones in the region. Eocene oil has been found in the Green River and Uinta basins.

From the beginning of the Paleozoic into the Tertiary, all major periods of geological time are proved producers of commercial amounts of hydrocarbons.

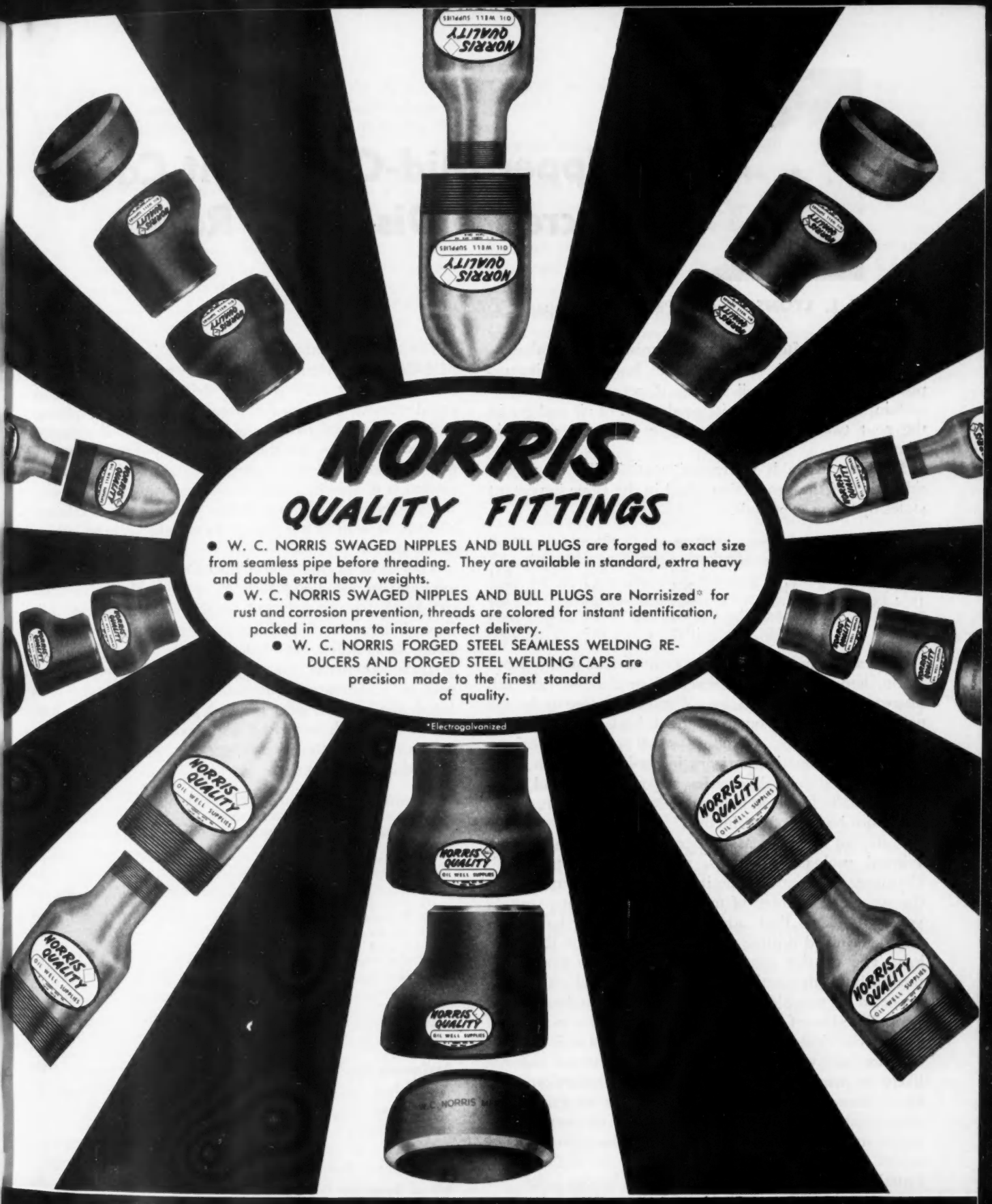
In Montana, positive elements have influenced accumulation in the Sweetgrass Arch and Big Snowy areas. In other parts of the state, negative elements are most important. The Williston Basin, a major sedimentary basin which lies partly in Montana, but which also extends into North and South Dakota, and into Canada, covers almost 120,000 square miles. It is an important producing area, and will increase in importance.

In Wyoming, most of the oil and gas fields have been found on the rims of structural basins (Baxter Basin is a prominent exception). In Colorado, there are important fields in the northwestern part of the state, but the greatest present activity is in the Denver-Cheyenne Basin. While many fields have been found in this basin, many more remain to be discovered, and pre-Cretaceous possibilities are as yet largely unexplored. Western Nebraska is a part of the Denver-Cheyenne Basin.

In Utah, the northeastern part of the state is the primary producing area, but significant shows in the southern portion of the state have been of considerable interest. In Northern New Mexico, all the oil and most of the gas fields are in the San Juan Basin, one of the world's major gas areas. Gas, which is rich in carbon dioxide, has been found in Northeastern New Mexico.

There are areas of merit in all of the states of the Rocky Mountain province. More important than in other regions, however, are the economic factors. Transportation of crude to other markets is still a problem. New pipe lines have been constructed; others are now in various stages of completion; still others are under consideration. Market demands are being met by additions to existing refineries and by new construction.

The outlook for future discoveries is indeed bright; there are important and sizable areas which have had virtually no exploration; and conditions are such that the future will lead to a marked increase in total reserves. In general, over the next few years, the various oil producing areas will maintain the same relative positions, but there will tend to be a shift of emphasis toward limits of the territory.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Upper Mid-Continent Can Increase Discovery Rate

By PAUL L. LYONS, Anchor Petroleum Company, Tulsa

THE UPPER MID-CONTINENT, consisting of Oklahoma, Kansas, and Illinois, and including Iowa and Missouri, presents prospects for oil and gas discoveries sufficient to sustain and even increase its production of oil and gas in the next twenty years, assuming a favorable economic climate.

This conclusion is warranted, statistically, by a consideration of the production of oil in the three important states by ten-year periods.

	Oklahoma	Kansas	Illinois	Total
	(Production in millions of barrels)			
1904-13	388	23	210	621
1914-23	1104	264	139	1507
1924-33	2038	385	68	2491
1934-43	1706	702	604	3012
1944-53	1586	1055	665	3306

The rate of increase is not as great as that of the population, and therefore an increased production rate and discovery rate is called for. The discoveries to be expected include, of course, a great host of "bread and butter" discoveries, including small pools, extensions, additional productive horizons in pools, etc. But a number of major field discoveries are necessary, and these fields, usually found in newly developing areas, must bear the major burden of production.

Sufficient large areas, under which there are undeveloped geological sections, exist in the upper Mid-Continent district to merit optimism concerning the discovery of a number of major pools in the next twenty years, provided that advanced exploration techniques and determined drilling are brought to bear on the problem. The district contains quite a high proportion of proven but only partially developed areas which may be expected to provide a sizable number of moderate sized pools. The law of diminishing returns applies to many of the heavily drilled areas of the district, but it is difficult to state just when an area is fully developed and not likely to provide significant additional production. Certainly dense drilling serves to define the structural and stratigraphic conditions of an area to the extent that more intelligent and accurate drilling locations may be made. As drilling increases, however, the size of pools found diminishes as they are restricted by dry holes.

In certain parts of all three states the drilling is so dense that certain areas may be said to be developed at least as far as the drill has penetrated in developed horizons. Even in these areas, however, the advent of "fracing" and secondary recovery techniques serves to lend a new impetus to drilling and production, so that these very areas will still provide substantial production during the next twenty years.

The most favorable areas for oil and gas in the upper Mid-Continent were developed, or partially developed, during the last fifty years of drilling. But perhaps an equal number of favorable areas remain to be exploited, and the modern more rapid drilling and exploitation rates will serve to put the finds quickly into the production column. This will serve to offset the less favorable prospects of the remaining virgin areas as compared with the slowly developed favorable areas already exploited. That is, we can develop areas in twenty years which formerly took fifty years.

The areas of the upper Mid-Continent awaiting full exploitation are listed here by their geological or geographical descriptions, and roughly in the order of their favorability and desirability from an exploration standpoint. Desirability enters the picture, because it must be possible to explore an area well and drill it at reasonable cost to make it attractive to operators. Of the areas listed, the first ten offer the best possibilities for the finding of large volumes of oil and gas. The remaining four are not out of the picture entirely, and should be regarded as "dark horses."

1. Ardmore Basin Extensions (Oklahoma)
2. Anadarko Basin (Oklahoma)
3. Oklahoma Panhandle-SW Kansas
4. Western Kansas
5. Salina Basin (Kansas)
6. Central and SW Illinois
7. NE Flank Arbuckle Mts. (Oklahoma)
8. Palo Duro Basin (Oklahoma)
9. Forrest City Basin (Kansas)
10. McAlester Basin (Oklahoma)
11. Ouachita Mts. (Oklahoma)
12. Extreme SE Oklahoma
13. NW Flank of Ozarks (Missouri)
14. Iowa

Expectations of these areas may be summarized as follows:

Ardmore Basin Extensions. Fabulous reserves have been established in the last five years in the Velma area of Oklahoma's Ardmore basin. The basin extends both to the northwest and southeast of the area of intensive development in the sandstones of the Deese and Springer formations. There is every reason to beleive that additional finds in both directions will be made where the objective formations are present.

Anadarko Basin. This vast basin is almost certain to yield a number of major accumulations as well as a goodly number of moderate sized pools. This is indicated by the sizable reserves of the large Elk City pool, near the deepest part of the basin, and by recent discoveries in widely separated Custer and Woods counties, as well

as by the stratigraphic accumulation in the Ringwood pool of Major County. All the usual productive horizons of Oklahoma are favorable for production, including the Chester section.

Oklahoma Panhandle-Southwest Kansas. The areas east and west of the Hugoton gas field offer great promise for both oil and gas development in multiple Pennsylvanian horizons and in the Permian near Hugoton itself. Immediately east of the Hugoton field, 37 oil and gas pools have been discovered in the last three years. West of Hugoton, 5 oil and gas pools have been found in the same length of time, including the obviously huge Greenwood gas field of Kansas and Oklahoma. Widespread extent of accumulations is indicated by the stratigraphic character of many of the traps.

Western Kansas. Western Kansas will provide many a small pool, perhaps a few large ones. Successive truncation of the Mississippian section on the west flank of the Barton arch has led to high hopes on the part of operators that the porous conditions in the truncated Arbuckle on the uplift with accompanying production will be repeated in the Mississippian limestones over vast areas of western Kansas. In the extreme western part of the state, Pennsylvanian limestones grade into sandstones, promising stratigraphic trap type accumulations if oil and gas are present.

Salina Basin. Potential site of many pools is the sparsely drilled Salina basin of Kansas. The sedimentary section, not unlike that of the remainder of Kansas, does not justify the avoidance oil men have given it. Porous Pennsylvanian limestones and sandstones, the Hunton, Trenton, Simpson, and Arbuckle are present at shallow depths.

The Salina basin is at present in much the same status as was the Denver basin several years ago. Seismic reflections are deceptively good, and several majors have given the basin a once-over-easy reconnaissance survey and have drilled what they considered to be prominent seismic anomalies. The same could also be said of the Denver basin prior to the oil discovery at Gurley, Nebraska.

Central and Southwest Illinois. The shallowness of the productive Chester section in the deep part of the Illinois-Indian basin has invited the drilling of so many thousands of wells that the law of diminishing returns has been operating for those formations. This dense drilling applies mostly to the Pennsylvanian and Chester sections, and, by contrast, the pre-Chester Mississippian, Devonian, and Silurian sections are somewhat sparsely drilled, and the Ordovician is very sparsely drilled.

Northeast Flank of Arbuckle Mountains. This favorable prospective area extends from the Fitts pool of Pontotoc County, Oklahoma, southeastward to the Oklahoma-Texas line. A portion of it lies beneath the Choctaw overthrust. The section is very favorable, the exploration is difficult.

Palo Duro Basin. The sedimentary section is fairly favorable, rather deep. The Strawn section looks good, and some reefing may be present in Pennsylvanian limestones. Oil and gas are present, but occurrences are hard to pinpoint.

Forrest City Basin. This basin will furnish a modest yield of oil pools. Nature has made it a tough nut to crack, and it is difficult to find a closed structure in a desired producing horizon because of unconformities and sedimentary variations. A favorable section is present, and oil, although not prolific, is certainly there for the keen and observant students of geology and seismology.

McAlester Basin. The high fixed carbon ratio has for years been held against this basin. With the exception of some shallow sands, much of the favorable section is rather deep, and the percentage of shale in the section increases greatly basinward at the expense of the sandstones. In recent years, rather general leasing activity through the basin indicates a sustained search for additional oil and gas, with the emphasis on the latter.

Ouachita Mountains. There are oil seeps in this province, and there are few shallow, inconsequential oil and gas pools. Some of the earliest geological exploration in Oklahoma occurred here, because the area looked favorable, at least structurally. Interest at present is focused on the possibility that high structural elements of Arbuckle type facies are present in places under the masking thrust sheets and are responsible for the seeps. The thrust sheets in themselves offer little promise.

Extreme Southeast Oklahoma. It is possible some sort of faulted extension of the Arbuckle Mountains may exist here, buried beneath Cretaceous rocks and the thrust sheets of the Ouachitas. A prominent gravity high and earthquake activity lend support to this wild speculation.

Northwest Flank of Ozarks. Extreme western Missouri has produced some gas, and there are some plans afoot for oil mining in outcropping rocks in this part of the state. Invasion by fresh water of the porous rocks of the sedimentary section in the northern part of Missouri has caused the majority of observers to regard the possible oil and gas traps as "flushed." The many water wells drilled without shows of oil and gas lend support to the conclusion that the hydrocarbons are gone.

Iowa. It is extremely strange that to this vast area the same statements apply as hold for northern Missouri. Some faint hope may be held for oil and gas accumulation in some Devonian sandstones present in the subsurface and in buried Silurian and Devonian reefs expected to be present.

To summarize, it is a difficult statement to make, but it would seem to be possible, from the geological data, that the rate of finding oil and gas reserves in the upper Mid-Continent district can be increased as much as necessary for perhaps 20 years. But to do this, the number of wells drilled in the area must be increased, and the depth of wells drilled must be increased. To bring about a realization of this, the incentive for such a drilling program must also be increased. —**The End**

Congressional Floor Fight Over Imports Dodged for a Year?

Oil and gas independents have decided to seek relief from what they term excessive imports under what they hope will be the protective umbrella of the **Reciprocal Trade Agreements Act.**

The executive committee of the Texas Independent Producers and Royalty Owners Association recently decided in a San Angelo, Texas, meeting that they should petition the U. S. Tariff Commission to study the imports problem to determine whether the domestic industry is entitled to tariff protection under the "escape clause" of the trade act.

A year's extension of that act has just been voted by the House of Representatives, which apparently is content to let the imports issue rock along until next year. The Senate is expected to follow suit.

The TIPRO action developed shortly before the Texas Railroad Commission sliced that state's oil production allowable for July by 190,234 barrels per day from the permissive flow which averaged 2,991,938 barrels a day for the week ending June 12.

Purchasers at the statewide proration hearing at San Angelo almost unanimously recommended the new allowable of 2,801,704 barrels a day. The new quota is based on a 16-day flow for all fields except Kelly-Snyder, which will operate 15 days, Sandusky, 13 days, and Picton, 9 days.

Railroad Commission Chairman Ernest O. Thompson, who recently began a survey of proposed import quotas, has been informed that:

- Standard Oil Company of California may reduce its imports. The company's imports for the May-through-September period calls for about 20,000 barrels daily or 17 percent less than for the corresponding period the previous year.
- Other proposed reductions in imports include Esso Standard, 14,000 barrels a day; The Texas Company, 8800 barrels daily; The Atlantic Refining Company, 6500 barrels daily; Gulf Oil Corporation, 13,000 barrels a day. Standard Oil Company (Indiana) and Socony-Vacuum Oil Company also are proposing cuts of smaller quantities.

Meanwhile, in rounding out another factor which enters the imports question, the Bureau of Mines has said total second quarter demand would include a decline of approximately 19 percent in exports. Actual imports averaged 653,000 barrels per day in March and 574,000 barrels daily in April. Bureau estimates put the average at 700,000 barrels a day in May, 650,000 barrels daily in June, and 660,000 barrels per day in July.

The problem of prices has been underscored—a topic which the Texas Railroad Commission has steadfastly refused to take into consideration as it does market demand and conservation. This time the pricing factor has been introduced by Sun Oil Company in a summary of the company's views written to Chairman Thompson by Sun President Robert G. Dunlop, who said his company plans to quit depending almost entirely on domestic crude supplies.

Dunlop's letter was in response to Thompson's request that all major companies consider cutting back imports during the last seven months of this year because of increasing stocks and increasing domestic oil producing capacity.

Sun's scheduled imports include 7500 barrels a day of special crude for its Marcus Hook, Pennsylvania, refinery. That rate will be raised to 11,000 barrels daily for September only.

Dunlop said Sun's earnings for the last six months of 1953 had been adversely affected to the extent of approximately $3.5 million after taxes as a result of curtailment of the company's crude oil productive capacity, particularly in Texas.

Since products demand has not lessened, Dunlop said the company has been forced to buy domestic crude "at market prices considerably in excess of the cost . . . at which such oil could have been produced from Sun's own wells."

The company official added: "Unfortunately, this condition still obtains and is particularly aggravating in connection with East Coast refinery operations where a majority of refineries are operating to a very material degree on low-cost foreign crude."

Sun's policy has been to buy crude from domestic producers, mostly independent operators, when extra volumes of crude were required. Exceptions have been made when foreign crude of special characteristics was needed.

That, at least, was one company's view.

North Dakota Warned of Gas Curbs

Marketing restraints of natural gas from North Dakota's oil pools to benefit the lignite coal industry could result in a sharp reduction in oil exploration and development, according to C. E. Boone, vice president of Amerada Petroleum Corporation, pioneer in the Williston Basin.

Addressing the North Dakota-Associated Press members at a meeting in Bismarck, N. D., Boone predicted that "any artificial restraint upon the marketing of oil and gas will bring about a substantial reduction in North Dakota oil exploration and development." Such a restraint by legislative enactment or order was "an unwise requirement so that oil and gas be hoarded for the future." He added:

"Recently we in North Dakota have heard and read a great deal about the natural gas business, and by some we have been asked to accept the proposition that one of North Dakota's new energy resources, natural gas, should not be allowed to compete freely in the open market with other fuels produced in the state."

He criticized the view that gas, called by some a "superior fuel" and a "premuim fuel" be hoarded for one use, that of the domestic consumer.

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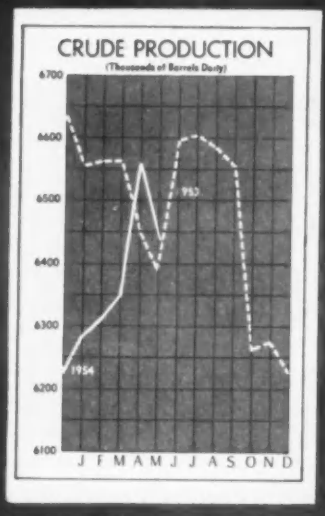
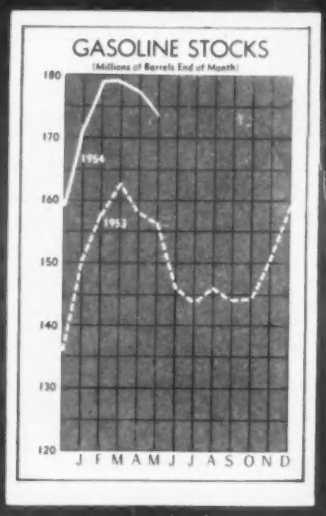
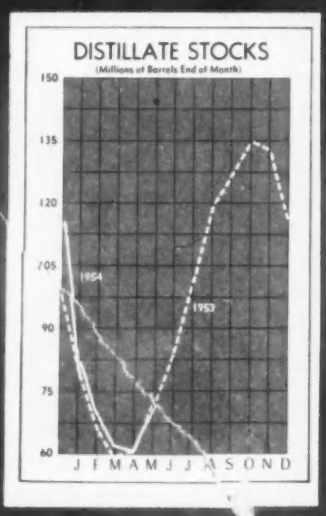
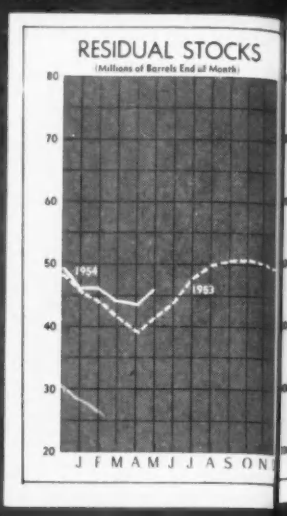
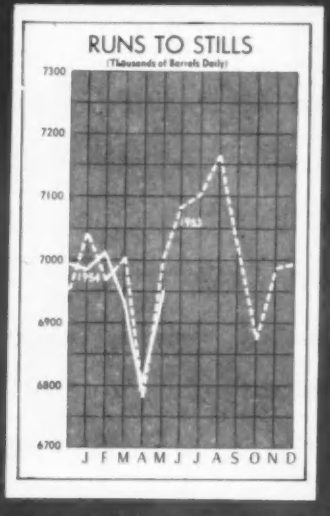
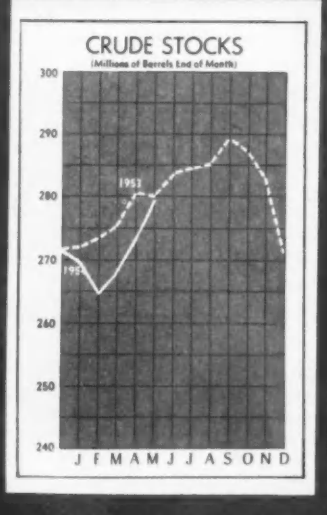












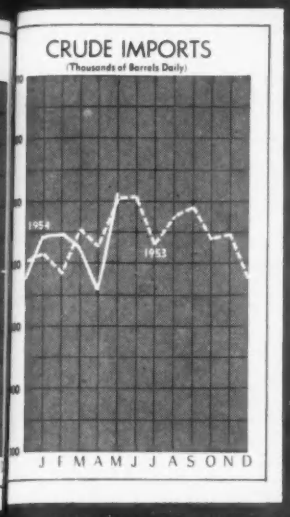
Petroleum Trends in the U. S. . .

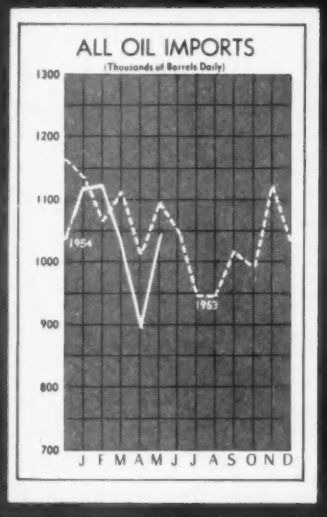
Crude imports at record level . . .

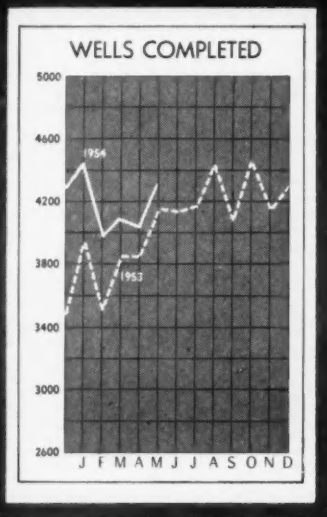
U. S. Crude Production by States

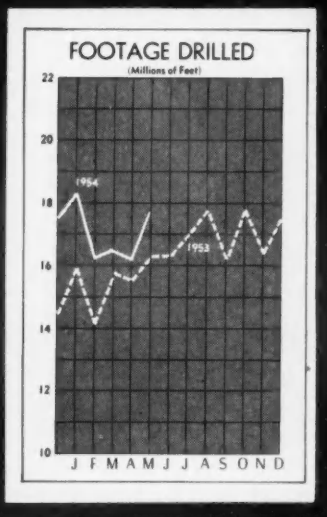
(THOUSANDS OF BARRELS)

STATE or DISTRICT	DAILY AVERAGE PRODUCTION May, 1954	April, 1954	May, 1953	% Diff. April, '53-'54	TOTAL PRODUCTION First Five Months 1954	1953	% Diff. '53-'54
Alabama	4.6	4.4	5.0	— 8.0	687	712	— 3.5
Arkansas	77.5	77.3	79.3	— 2.3	12,018	12,214	— 1.6
California	985.1	985.0	1,003.1	— 1.8	149,669	150,291	— 0.4
Colorado	125.3	125.1	86.0	+ 45.7	16,294	12,462	+ 30.7
Florida	1.6	1.6	1.5	+ 6.7	234	225	+ 4.0
Illinois	184.0	178.6	157.7	+ 16.7	26,650	24,296	+ 10.1
Indiana	31.0	31.3	37.5	— 17.3	4,827	5,504	— 12.3
Kansas	329.6	332.1	321.8	+ 2.4	49,254	50,196	— 1.9
Kentucky	36.6	35.6	30.4	+ 20.4	5,492	4,611	+ 19.1
Louisiana	713.4	722.5	690.0	+ 3.4	106,452	106,520	— 0.1
North Louisiana	112.4	111.4	108.8	+ 3.3	17,142	17,483	— 2.0
South Louisiana	601.0	611.1	581.2	+ 3.4	89,310	89,037	+ 0.3
Michigan	35.6	35.7	32.6	+ 9.2	5,191	5,105	+ 1.7
Mississippi	92.2	92.0	97.3	— 5.3	14,077	14,980	— 6.0
Missouri	0.1	0.1	0.1		22	10	+120.0
Montana	35.4	32.6	32.7	+ 8.3	5,077	4,562	+ 11.3
Nebraska	20.3	19.9	16.2	+ 25.3	2,898	2,326	+ 24.6
New Mexico	203.9	205.8	192.5	+ 5.9	30,510	28,071	+ 8.7
New York	11.5	11.8	10.4	+ 10.6	1,533	1,618	— 5.3
North Dakota	13.7	13.7	14.2	— 3.5	2,181	2,217	— 1.6
Ohio	11.2	11.3	9.0	+ 24.4	1,630	1,361	+ 19.8
Oklahoma	539.2	529.8	555.7	— 3.0	81,561	84,011	— 2.9
Pennsylvania	24.0	24.4	28.8	— 16.7	3,858	4,442	— 13.2
South Dakota	0.1				7		
Tennessee	0.1	0.1	0.1		7	4	+ 75.0
Texas	2,699.1	2,847.3	2,754.6	— 2.0	411,381	430,716	— 4.5
Dist. 1—South Central	42.1	42.1	35.4	+ 18.9	6,224	5,471	+ 13.8
Dist. 2—Middle Gulf	146.8	155.7	152.8	— 3.9	21,198	24,040	— 11.8
Dist. 3—Upper Gulf	441.0	456.6	461.6	— 4.5	63,613	72,554	— 12.3
Dist. 4—Lower Gulf-S.W.	246.8	262.2	254.5	— 3.0	37,201	39,109	— 4.9
Dist. 5—East Central	44.6	48.5	47.2	— 5.5	6,740	7,492	— 10.0
Dist. 6—Northeast	345.3	372.6	372.9	— 7.4	52,739	52,711	— 8.6
Dist. 7-B—North Central	119.7	138.8	108.0	+ 10.8	19,343	16,302	+ 18.7
Dist. 7-C—West Central	183.2	188.1	154.6	+ 18.5	26,755	24,997	+ 7.0
Dist. 8—West	860.4	901.6	887.7	— 3.1	130,239	138,997	— 6.3
Dist. 9—North	188.9	194.6	169.0	+ 11.8	28,513	27,117	+ 5.1
Dist. 10—Panhandle	80.3	86.5	72.7	+ 10.5	12,408	11,279	+ 10.0
Utah	5.4	5.3	5.3	+ 1.9	802	800	+ 0.3
Virginia	0.1	0.1	0.1		8	4	+100.0
West Virginia	7.8	8.2	7.9	— 1.3	1,255	1,110	+ 13.1
Wyoming	249.4	248.4	220.3	+ 13.2	37,154	32,615	+ 13.9
Total United States	6,437.8	6,586.0	6,390.1	+ 0.7	970,729	980,883	— 1.0









By CECIL W. SMITH, World Oil Staff

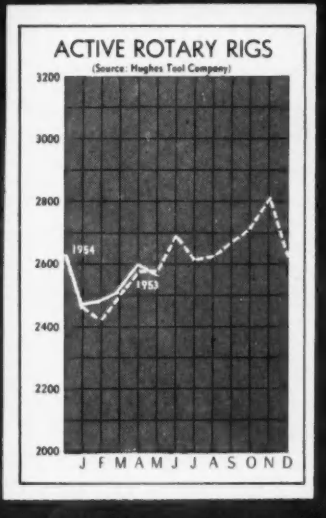
Drilling rates increased . . .

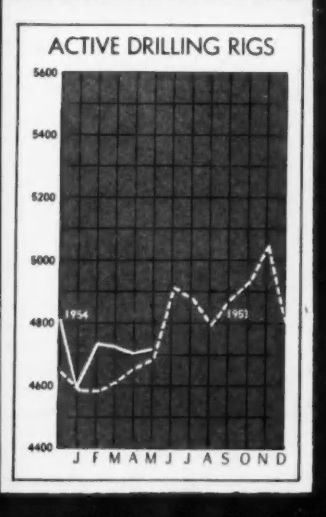
. . . Fuel stocks begin seasonal hike

Crude Oil and Refined Products Trends
(THOUSANDS OF BARRELS)

	CRUDE OIL			GASOLINE		DISTILLATE FUEL		RESIDUAL FUEL		DAILY IMPORTS	
MONTH	Production Daily	Runs to Stills Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Crude Oil	Total Oils
1952:											
April	6,429	6,435	270,679	2,995	151,890	1,312	51,634	1,253	38,561	539	922
May	5,107	4,905	290,813	2,295	123,656	982	51,648	979	38,821	545	951
June	6,197	6,825	285,964	3,169	120,166	1,455	65,911	1,228	45,688	581	911
July	6,093	6,927	275,951	3,295	116,566	1,475	85,775	1,237	52,245	597	892
August	6,219	7,118	264,368	3,377	118,592	1,514	104,257	1,252	54,061	632	879
September	6,518	7,017	264,723	3,428	120,991	1,502	117,252	1,230	56,200	615	932
October	6,518	6,883	269,776	3,301	120,062	1,458	120,721	1,203	53,052	643	1,037
November	6,487	7,049	267,852	3,416	129,509	1,510	116,096	1,299	53,069	624	984
December	6,634	6,952	271,928	3,361	136,028	1,509	99,582	1,302	48,706	603	1,165
1953:											
January	6,555	7,042	272,250	3,384	150,518	1,528	80,655	1,307	45,910	616	1,135
February	6,562	6,969	273,589	3,379	157,873	1,505	67,167	1,275	44,178	586	1,066
March	6,531	7,002	275,665	3,319	162,731	1,489	59,802	1,256	41,600	655	1,112
April	6,446	6,781	280,487	3,282	158,032	1,424	61,349	1,219	39,572	628	1,010
May	6,390	7,002	280,308	3,459	156,415	1,400	73,706	1,197	41,795	703	1,096
June	6,595	7,081	283,715	3,467	146,196	1,462	84,504	1,238	43,801	707	1,050
July	6,603	7,103	284,976	3,583	143,916	1,441	102,394	1,224	47,966	629	946
August	6,583	7,163	285,352	3,592	146,050	1,437	119,542	1,222	50,007	672	946
September	6,557	7,023	289,614	3,521	144,184	1,448	126,709	1,203	50,516	692	1,013
October	6,262	6,872	287,541	3,437	144,495	1,462	135,409	1,184	50,820	639	990
November	6,277	6,987	283,021	3,528	150,747	1,463	133,381	1,223	51,267	648	1,120
December	6,238	6,964	276,676	3,628	159,949	1,441	111,944	1,247	49,370	598	1,121
1954:											
January	6,240	6,947	270,811	3,431	171,704	1,550	81,044	1,271	47,474	617	1,143
February	6,379	7,068	266,918	3,476	179,950	1,545	70,390	1,241	47,119	621	1,144
March	6,507	6,923	271,867	3,375	181,297	1,458	60,270	1,168	44,249	654	1,088
April	6,580	6,791	273,860	3,241	177,197	1,359	61,050	1,183	43,611	551	896
May	6,438	6,958	279,054	3,326	173,097	1,330	72,233	1,166	46,452	716	1,044
May, 1954 Change:											
In Month	—142	+167	+5,194	+85	—4,100	—29	+11,183	—17	+2,841	+165	+148
In Year	+48	—44	—1,254	—133	+16,682	—70	—1,473	—31	+4,657	+13	—52
Week Ended:											
6-11-54	6,495	6,820	276,185	3,276	171,303	1,399	77,495	1,208	48,530	482	799
6-12-53	6,477	7,026	278,960	3,381	149,288	1,404	79,185	1,229	43,595	788	1,124

Source: Data for last two months from API: prior monthly data from Bureau of Mines.





By **RAY L. DUDLEY,** Publisher, and **WARREN L. BAKER,** Editor

Gasoline Output Must Be Reduced

THE ECONOMIC OUTLOOK for petroleum is not encouraging. The supply of both crude oil and motor fuel has been too high, especially in the face of a comparatively small increase in consumption. Consequently, the industry has been unable to reduce excessive inventory levels.

So far this year proper precautions have not been exercised with respect to supplies. U. S. crude production needs to be reduced. Imports should be curtailed. Refinery output of gasoline should be cut. These moves are necessary to permit reductions in inventories.

Unless greater caution is shown, inventories may become a serious problem during the next few months. This is particularly true of gasoline. Motor fuel demand will start dropping to winter levels in October. This leaves the industry with only three months to make major reductions in gasoline stocks.

There is nothing in the situation, however, which the proper regulation of crude production, imports and gasoline output would not cure. Excessive volumes would be drawn from inventories if supplies are held to reasonable amounts during the next three months.

•

CHIEF HEADACHE is excessive gasoline inventories. Motor fuel stocks in mid-June totaled 171⅓ million barrels, after dropping only 4½ million barrels during the past four weeks. At this level they were 22 million barrels higher than a year ago. At the end of March, start of the motor fuel consuming season, they were only 16½ million barrels above the same date in 1953. In making comparisons with 1953, it must be remembered that inventories last year also were high in relation to demand.

Crude runs to stills during the first 24 weeks of 1954 averaged a shade under rates in the corresponding period of 1953. However, inventory levels at the start of the year had indicated a major reduction in runs would be necessary. With lower than anticipated consumption existing, reduced crude runs become more and more desirable. The industry has failed to reduce its refining operations in accordance with this picture. More importantly, the output of gasoline has increased despite some curtailment in crude runs.

Because of high gasoline yields, motor fuel stocks in 1954 have dropped at a rate of only 96,000 barrels per day from the end of March to mid-June. This was less than one-third of the withdrawal rate of 288,000 barrels daily in the same period of 1953. Consequently, the number of days' supply of motor fuel in storage currently is nearly 9 percent larger than a year ago.

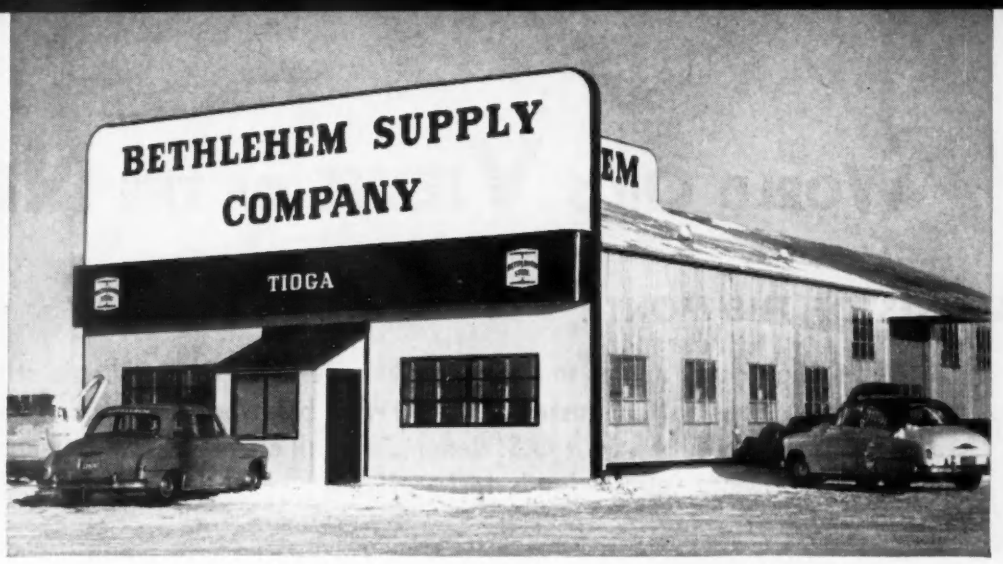
Although entering the peak gasoline consuming period, motor fuel price wars continue to exist in the Atlantic Seaboard region.

Approximately 25 million barrels of gasoline need to be drawn from storage during the next three or four months. This can be achieved only if refiners hold the output of motor fuel below 1953 levels in July, August and September. They are afforded a wonderful opportunity because of the high volume of gasoline manufactured in these months last year. Motor fuel output during these months is the key to the industry's future economic position.

•

LITTLE ENCOURAGEMENT is offered U. S. producers for the immediate future. Stocks of crude currently are 11½ million barrels higher than at the end of February, 1954. Ten to 12 million barrels should be drawn from storage. Promises by several companies that future imports will be reduced will give little relief.

Any increases in producing rates as long as crude oil and gasoline inventories remain excessive would be highly dangerous to the price structure already softened by gasoline price cutting. If refinery runs are held down to desired levels, less crude will be required during the next three months. On the other hand, if refinery runs are not held down, reduced crude prices become a threat.



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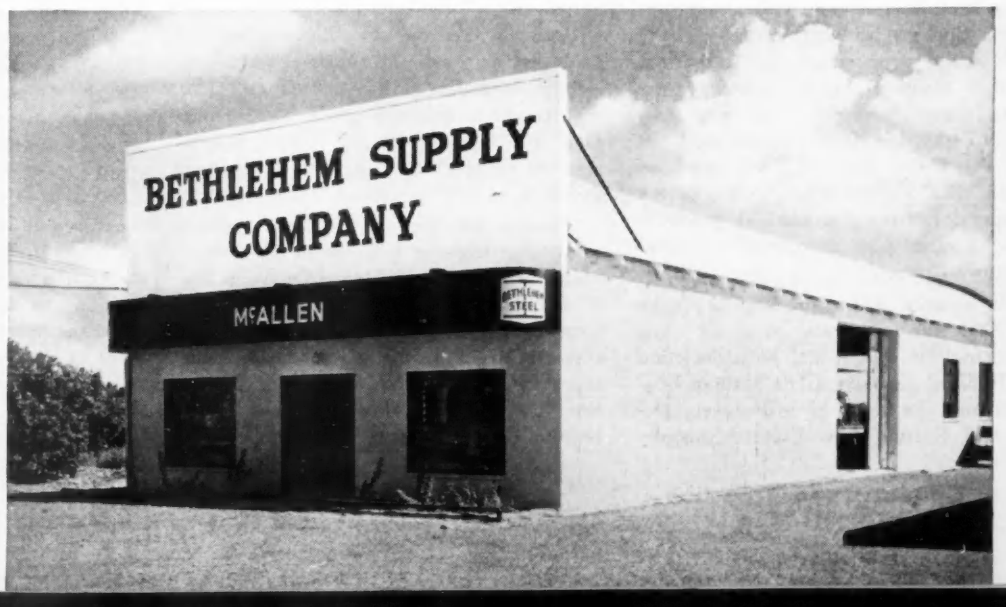


WORLD OIL'S VIEWS OF THE NEWS

HEADLINES OF THE MONTH

• High court makes unwilling bookkeeper of FPC . . . • Legislative history shows Congress sides with industry . . . • OWIU bids for peace and goodwill plus 5 percent hourly pay hike . . . • U.S. demand for all oil rises . . . • Offshore work at fast tempo . . . • More federal lands to be offered

FPC: Unwilling Bookkeeper

The Supreme Court last month made a bookkeeping agency of the Federal Power Commission and natural gas companies of 2500 independent producers.

In ruling, 5 to 3, that **Phillips** Petroleum Company's sales of natural gas to interstate pipe line companies are subject to regulation by FPC, the court was decreeing that the commission must no longer shrink from its rate-making authority over independent producers whose sales to interstate lines have heretofore been free from government intervention.

The court said, in a majority opinion by Justice Minton, that it was satisfied that when Congress passed the Natural Gas Act it sought "to regulate wholesale natural gas occurring at both ends of the interstate transmission systems."

As a company which sells gas it has produced itself or gathered from other independent producers, Phillips had joined FPC in arguing that it is not a natural gas company within the meaning of the Natural Gas Act and therefore is not within the commission's rate-making jurisdiction. Phillips and FPC granted that the company makes sales to interstate pipe line companies, but argued that these sales are a part of production and gathering.

The Court, however, said production and gathering phases had already ended by the time Phillips made its sales to pipe line companies.

In a scathing dissent Justice Clark, with Justice Burton concurring, said that perhaps Congress should have given FPC control over production and gathering, but that Congress had specifically exempted those categories. Yet, they said, in face of this specific exemption by Congress, the Court majority had issued an opinion that, on its face, "brings every gas operator, from the smallest producer to the largest pipe line, under federal regulatory control."

It is exactly this regulatory headache that FPC was attempting to avoid when it held in 1951 that it had no jurisdiction over Phillips' gas sales. (The State of Wisconsin and the cities of Milwaukee, Detroit and Kansas City disputed this decision before the Court of Appeals, which reversed FPC. Phillips, FPC and the State of Texas then appealed the court's decision. The High Court first refused to review the case, then reversed itself and accepted the suit.)

The first migraine FPC must suffer is to determine how far the ruling extends. Are there some points unique to Phillips? Does it completely cover the 2500 independents who sell to interstate pipe line companies? Does it cover the approximately 15,000 independent producers of oil who have some gas production and at some future date may want to sell to an interstate company?

To clarify these points, FPC must consult the courts. Next, the commission would have to recruit accountants and a field staff to study the operations and books of each producer within its jurisdiction. Earnings would have to be ascertained; rate schedules would have to be issued.

Then an attempt would have to be made to segregate oil income from gas income in order to learn what earnings each producer derives from its gas. Finally each producer would have to decide whether to establish a separate company to handle its gas operations.

Chances are, before FPC got around to shouldering the entirety of its impossible burden, Congress would have taken it out of the bookkeeping business by passing legislation saying what the Natural Gas Act tried to say 16 years ago. But there can be no such relief this year—first, because time is short, and second, because Congressmen from consumer states would risk having their political pants burned off if they snuggled up to so flaming an issue in an election year.

However, it appeared last month that a delay in the legislation won't cause the confusion to be compounded by precipitate action from FPC. The commission was approaching its onerous task at something less than a dog-trot. Commissioner Draper said FPC would probably start an investigation, including public hearings, as soon as possible to determine whether Phillips' present rates are fair and reasonable. He indicated this would probably be the first specific case in which the commission exercises its new authority over the independents.

Other rate review proceedings will be undertaken, he said, whenever there's a question as to the reasonableness of the independent producer's rates. Thus, for what small comfort they could gain from it, it seemed that at least some of the independents were in much the position of a motorist driving without a license. They were safe until and unless they were arrested for speeding.

Conflicts Likely

Once FPC goes into action, it will likely run afoul proration laws. Chairman Ernest O. Thompson of the Texas Railroad Commission visualized a situation like this: Gas from a given well is tied up under a long-term contract to an interstate pipe line, which would make it under FPC jurisdiction. However, the state regulatory body might find that the gas should be returned to the producing horizon to maintain pressures.

Another state-federal conflict would be brought about by the minimum price law suggested by President Jack Woodward of Texas Independent Producers and Royalty Owners Association. If the FPC ceiling collided with the Texas floor, the courts would be needed to pry them apart.

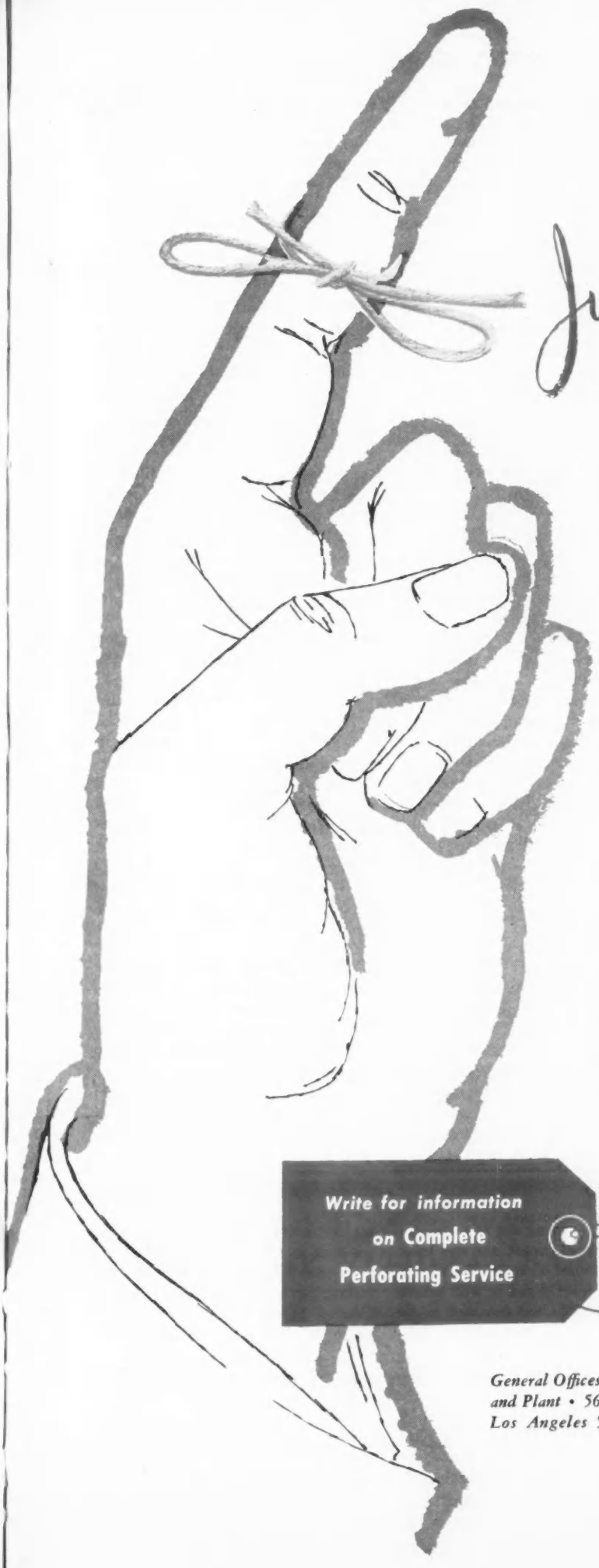
Chairman K. S. Adams of Phillips met the court's decision with determination to petition the court for a rehearing.

Adams pointed to the one all-important point in the controversy which many outside the industry refuse to understand: "Left free of federal regulation the gas producing industry has made great prog-

Nevada is 29th Oil State

Nevada became the nation's 29th oil-producing state last month with the completion of Shell Oil Company's Eagle Springs Unit 1 in Nye County, 60 miles southeast of Ely.

On 24-hour test the well pumped 410 barrels daily gross with a 9 percent cut, or 373 barrels of clean oil. The well is producing from 6430-6730 feet.



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ress in making available to the numerous consumers throughout the U. S. a supply of natural gas at prices cheaper than those for less desirable fuels. Field prices of gas have been quite reasonable. They represent only a small portion of the consumer's bill. It is to the interest of interstate consumers that the business of searching for gas be continued without impairment and that the gas which is found not be confined to local markets."

Adams' hint that the independents may withhold gas from the market, to the ultimate detriment of the consumer, rather than submit to FPC control was phrased more bluntly by Hines H. Baker, president of Humble Oil & Refining Company. Said he ". . . the serious question arises as to whether gas producers can afford to make further interstate sales of gas for resale even though the demands for natural gas are increasing rapidly. The risks involved in natural gas production make it impossible for the gas producer to operate as a public utility."

OWIU Stages Juggling Act

Like a singing juggler with four balls in mid-air, the Oil Workers International Union set up a chant for a 5 percent wage hike and a big new labor organization last month while simultaneously attempting to soothe management, entice independents into the field, lull the fears of rival unions, and draw tighter **the bonds** within its own rank and file.

Main acts of the week-long OWIU show were:

- The demand that about 11.25 cents be tacked onto the worker's average hourly wage of $2.25; and
- The delivery of the 130,000-member Oil Workers International Union to the burgeoning Oil and Chemical Workers Union, which was conceived of the despair among OWIU leaders of ever achieving nationwide bargaining with the present limited membership.

But the flashiest performances came in the one-man side shows staged by President and Chief Prestidigitator O. A. (Jack) Knight, who tossed up a cluster of placatory broadsides.

For management's benefit, Knight delivered the unprecedented promise that his union would not strike, threaten to strike, or take a strike vote during wage negotiations. However, the promise does not apply to issues other than wages, and the way was left open to revoking the promise in the event that talks do not progress satisfactorily.

Further, said Knight, employers will learn to cherish the new union as a trouble-stopper (see below).

Turning to the independents, many of whom have accused OWIU of sponsoring this new union as a means of gobbling them up, Knight urged them to take their time about ratifying the new organization. "We want all the unions and their members to have time to study the matter carefully and to understand it well before they take any action," he declared in an effort to avoid being accused of high-pressuring the small groups. However, he followed this pronouncement with a veiled warning that charter memberships in the new setup won't be open forever. A merger convention will not be called until several other unions have approved, he declared, but proceedings won't be held up until the new organization is approved by all 31 unions represented at the initial meeting in Philadelphia early in the year.

(Some independents immediately began falling in line. The first of 26 locals of Central States Petroleum Union to vote on the merger approved it by 571 to 375.)

For rival unions fearful of the big new union, Knight also had a soothing gesture. A "no-raiding" pact was discussed with representatives of the AFL Teamsters Union, which has concentrated on service stations, whereas OWIU has directed its efforts into other fields.

Not overlooked by Knight in the dis-

Court Makes History—Does It Read It?

Industry had cause to wonder last month if the Supreme Court was too busy making history to read some of it.

The court declared in its ruling against Phillips: "Rather, we believe that the legislative history indicates a congressional intent to give the commission jurisdiction over the rates of all wholesales of natural gas in interstate commerce, whether by a pipe line company or not and whether occurring before, during or after transmission by an interstate pipe line company."

Here, in brief, is the legislative history indicating congressional intent:

- In 1938 President Roosevelt signed the Lea Bill into law, making it the Natural Gas Act.

(In searching for a pattern to regulate an industry that was just then growing into the interstate field, Congress turned to the rules governing railroads and other carriers operating in interstate commerce. It was intended to regulate the earnings of gas pipe lines engaged in transporting natural gas in interstate commerce and in selling such gas for resale for ultimate public consumption. There are sound reasons to believe that those who drafted the act had no more intention of granting jurisdiction over gas before it entered an interstate line than the originators of the railroad regulations had of controlling the price of steel or grain before it went into interstate transportation. Hence FPC was given powers approximately paralleling those of the Interstate Commerce Commission.

(Section 1 of the Act closed with the specific denial to FPC of any jurisdiction over ". . . the production and gathering of natural gas," i.e., sales at arm's length. But FPC, with backing from the High Court, attempted to diminish the meaning of the words "production" and "gathering" as to signify only the management of drilling rigs, pumps, and flow tanks. It was to clarify this point that Congress next took action.)

- In 1947 the House passed the Moore-Rizley Bill, which died in the Senate subcommittee, principally because it would have limited FPC's authority over sales made by natural gas companies operating in interstate commerce.
- In 1949, the House passed the Harris Bill, companion measure to the Senate-sponsored Kerr Bill.
- In 1950, both the Senate and House passed the Kerr-Harris Bill—a bill which Senator Kerr had described in the subcommittee as a routine measure introduced for the purpose of ". . . clarifying language, which as Senator Reed has so aptly said here, there was no question about when it was passed in the original Natural Gas Act."

(President Truman vetoed this bill in the face of a furore which argued that it would leave the consumers at the mercy of the independent gas producers, who could then charge any price they desired. The fallacy here was that the consumer had ALWAYS been at the mercy of the independent producer for the reason that the independent producer had NEVER been regulated. And with what result? The retail price index for gas in 1949, with natural gas having been approximately 84 percent of the total volume, was less than 2 percent above the 1935-39 average.)

Thus, the box score on congressional intent shows that industry's stand has been approved four times by the House of Representatives and twice by the Senate.

Mr. "M" was the picture of health

Mr. M. was in the best of health, and when we first suggested that he take certain steps in case of death he thought it was a lot of needless trouble. We showed him how our Trust Department could arrange his affairs in an orderly way, and allow his operation to continue after his death.

Following the advice of our Trust Department, he had his lawyer draw up a will for him. And, even though he thought it was a waste of time, he had his wife's will made, too. His finances were set up to run as smoothly and as efficiently as his oil operation. Every future possibility had been taken care of in the plans made by the Trust Department.

Now this story has a twist. Mr. M hasn't died yet. But he lives in Texas, and his wife died early in the year. Had she died without a will, and if her community property share of his operations had not been taken care of by such will, he would have had a sizable part of his estate tied up in court proceedings for many months. He would have missed out on an excellent deal which he was able to make. And now he knows that when he does die his children will benefit, through this orderly financial arrangement, from the energy and hard work he put into building his holdings.

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tribution of blandishments were the rank-and-file of his own OWIU, traditionally one of the most fiercely democratic in American labor. Harmony during this touchy period was assured, insofar as he could assure it, by permitting the locals to work out such matters as a shorter work week and improved pensions. Even the 5 percent wage hike goal may be increased by locals under "special" circumstances, Knight declared.

Basis for Pay Demand

In lining up arguments for a pay increase, OWIU led off with an old reliable: Increasing productivity.

"While the number of workers employed by the oil industry is steadily declining," said the policy committee, "the volume of production, the volume of sales and the net profit of the oil companies continue to increase."

Then came a somewhat breathless flyer into elevated economics: Increasing productivity in general.

"Throughout our economy," was the lofty explanation of what's this got to do with it, "production is increasing—at a much faster rate than consumption. Increased wages are needed to stimulate purchasing power and thereby provide a market for the increasing flow of consumer goods."

The final argument was back on the rank-and-file level: Insufficient compensation for the skills of oil workers.

"The application of elaborate new equipment, electronic controls and other automatic devices in the oil industry requires an ever higher level of skill on the part of oil workers.

"Oil workers' wages, while high in relation to those in some other mass production industries, are in many cases low in relation to the skills required."

Knight Caught off Base

Jack Knight's zeal to slide home with an organization of all industry workers caused him to get caught off third base last month. Knight declared that industries which recognize strong national unions have less labor trouble than "half-organized" industries. "Sure," he said, "there is a lot of publicity when steelworkers strike or when General Motors is shut down by the auto workers, but over the years I dare say these companies lose less production than those industries which have a muddled bargaining situation—such as oil." Whereupon the National Petroleum Association's weekly news bulletin replied with figures for 1945-52, inclusive, from the Bureau of Labor Statistics:

Industry	Number of Strikes	Man-days Idle
Bituminous	4019	65,924,000
Basic steel	869	43,828,000
Automobiles	869	35,961,000
Petroleum Refining	90	3,155,300

In brief . . .

American Pipe Line Corporation of New York was granted an amended certificate of necessity permitting it to write off at fast rates 40 percent of $170 million of pipe line facilities. This replaced an earlier certificate which allowed the company only 25 percent of $158 million for the same project. The certificate covers a line to be constructed from the Houston-Beaumont area to Newark, N. J., a distance of 1425 miles. The fast writeoff was granted on the grounds that the additional capacity is desirable for defense.

•

A British and two American companies will soon begin wide-scale prospecting in India's Bengal Basin. Standard Oil Company (New Jersey) has signed a government contract, promising to erect a refinery if drilling operations are successful. Caltex, Ltd., and Assam Oil Company are the other companies.

•

Eleven oil companies and one independent oil man have bid for government-owned synthetic rubber facilities. Edwin W. Pauley of California was the only individual named in the list. Oil companies who bid under various names, and some in combination with firms outside oil industry, were Richfield, Esso Standard, Gulf, Humble, Cities Service, Continental, Phillips, Shell, Sinclair, Standard of California and Texaco.

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Fuel oil use at power plants continues to lose ground to natural gas FPC reported. April's oil consumption was 4,783,-134 barrels, down 33 percent from the same month a year ago. April gas use was more than 91 billion cubic feet, up 19 percent from a year ago. Coal consumption was 8.7 million tons, down 2.6 percent from a year ago.

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The Texas Company may build a $2,-225,000 West Coast headquarters building in Los Angeles if City Council approves request for a zoning change.

•

New England fuel oil dealers have taken up the cudgel in earnest against the natural gas invasion. The Independent Oil Men's Association of New England called for assessments of $500 per 1 million gallons of fuel oil volume to do a selling job for oil.

•

A U. S. allotment of $30 million to Turkey was announced by Foreign Operations Administration. The money will be used to purchase such items as jet fuel, lubricants, tires and batteries.

Demand Up Slightly

The total demand for all oils to be supplied by the U. S. petroleum industry in 1954 will be only 2.1 percent greater than in 1953, according to the revised forecast of the Bureau of Mines. This represents a downward revision from the estimate originally made late last year.

Holding down the requirements will be the substantially lower level of exports, which are now expected to be 20.2 percent less than in 1953. Domestic consumption of all oils will be 3.3 percent larger in 1954 than in 1953, it is anticipated.

By quarters, the total demand will show rather widely varying increases over the like periods of last year. There was an actual gain of 1.5 percent in the first quarter, the report showed. For the second quarter an increase of only 0.3 percent is indicated. In the third quarter there will be an increase of 2.2 percent over last year, it is estimated. Finally, for the fourth quarter, a gain of 4.9 percent is forecast.

The 20.2 percent drop in total exports will include a decrease of about 40 percent in crude exports and a decline of 17 percent in exports of refined products, the revised forecast indicates. In the first quarter there were actual decreases of 49.1 percent in crude exports and 17.0 percent in product exports. Principal reason for the decline in crude exports is the completion of new pipe lines in Canada to supply local refineries with crude of Canadian origin.

The forecast 3.3 percent gain in domestic demand in 1954 includes an increase of 3.3 percent in gasoline demand for the year, a decline of 3.3 percent in demand for residual fuel oil, and gains of 8.0 percent for distillate fuel oil, 5.7 percent for kerosine, 49.3 percent for jet fuels, and 2.4 percent for other products in the aggregate. The actual change in domestic demand in the first quarter of 1954 was a total gain of 2.8 percent, including an increase of 3.0 percent for gasoline, a decline of 5.0 percent for residual, gains of 9.4 percent for distillate and 4.8 percent for kerosine, an increase of 52.3 percent for jet fuels, and a decline of 0.8 percent for other products.

For the latter half of 1954, domestic demand for all oils will be about 4.6 percent larger than for the like period of 1953, the new forecast indicates. This will compare with an increase of only 2.0 percent for the first half of 1954. The larger increase for the second half is expected for several reasons. It is based especially on the assumption that weather will be normal in the last quarter, in contrast with mild weather in the last quarter of 1953. Furthermore, there is expected some improvement in the industrial demand for

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oils, whereas there was a sharp relative decline in the last quarter of 1953.

An increase of only 0.8 percent in the new supply of all oils in 1954 is forecast, including a gain of 0.1 percent in required crude production, an increase of 5.6 percent in the production of light oils derived from natural gas, and a gain of 2.0 percent in total imports of crude and products. The forecast indicates an increase of 0.2 percent in the demand for domestic crude oil and a gain of 0.6 percent in total crude runs to stills. The smaller relative gain in required new supply is related to the increase of 54 million barrels in total oil stocks in 1953, compared with the forecast of an increase of 14 million in total stocks in 1954. In the first half of 1954, compared with the same period in 1953, the estimated demand for domestic crude oil declined 0.9 percent, and total crude runs to stills decreased 0.4 percent.

Safety Award Offered

The API performed another service to the industry last month by establishing a Meritorious Safety Award to recognize outstanding acts of heroism and first aid in the petroleum industry.

The award consists of a certificate citing details of the act, a medal encased in a transparent block of lucite, and a lapel pin. The certificate is to be signed by the president of the Institute and the head of the employe's company.

Only those acts performed since January 1, 1953, will be recognized. Qualifications state that "any person affiliated with the petroleum industry who, in the line of his duty or off the job, saves a life either because of an act of heroism which involved the risk of his own life, or because of the successful administration of first aid" is eligible.

Sonic Drill Incomplete

Erroneous and unauthorized reports in a trade publication other than WORLD OIL as to field tests of Borg-Warner's sonic drill were deplored last month by Dr. Maurice Nelles, director of the Borg-Warner Central Research Laboratory at Bellwood, Ill.

"The sonic drill is still in the experimental stage," he declared. "We had hoped that by this time it would be ready for release for production; however, some of the problems of sealing and providing life in some of the parts have taken longer than anticipated. It, of course, is true that we have run drilling tests in several fields, but these have been only for a matter of minutes to obtain instrumented data. These are not drill tests in the conventional meaning, and as is generally understood by the petroleum industry where sustained drilling is assumed."

A MAN-MADE ISLAND is the method to be used by Brown Marine Drilling Company at a test off Seal Beach, Calif., for Monterey Oil Company and The Texas Company. The concrete island is 75 feet in diameter and the adjoining pipe-driven superstructure is 72½- by 56½-feet in diameter.

Full Speed Offshore

Texas-Louisiana Continental Shelf operations, long hobbled by war and its shortages and then by the federal-state controversy and its uncertainties, are being pushed toward a dazzling tempo by a fabulous outlay of money, energy and brains.

This can be illustrated by progress made and anticipated in just three phases of the tremendous undertaking as cited last month by Ben C. Belt, vice president of production for the Houston division of Gulf Oil Corporation, before a group of oil writers at a Deepwater Press Party at Corpus Christi.

- **In Exploration:** Operations have progressed so rapidly in recent years that in all probability 10 to 14 oil companies have done seismograph work on 70 to 100 percent of land bounded on the north by the shore, on the east by the Mississippi River, on the west by the Rio Grande, and on the south by the 120-foot depth line.

- **In Drilling Technique:** The LST which Gulf converted at a cost of about $2½ million to drill on its block off Texas will be obsolete within a very few years.

- **In Development:** The spirited campaign in the next five years could easily add from 4 to 6 billion barrels of oil to our national reserves and might add about 15 or 20 trillion cubic feet to our gas reserves. This possibility gains impressiveness when compared with the sum total of accomplishments since 1945. There are now on the Continental Shelf only 14 oil fields producing 25,000 barrels per day from 118 wells. There are 12 gas fields (most of them shut in), with four of them producing in excess of 150 million cubic feet per day.

Belt gave the oil writers some plain talk on why the majors are throwing their weight into an operation so expensive that a 10,000 foot well drilled for $1 million will be a rare bargain indeed, and an oil field with an estimated ultimate yield of 10 million barrels "will have to be handled as a fisherman handles a 'non-keeping' fish and merely thrown back into the sea."

The majors, he said, are comparing the 15 million acres lying inside the 150-foot depth line, and which is underlain by Miocene and Plio-Miocene, with the 9½ million acres underlain by Miocene which lies next to the shore line along this strip of coast. In the latter 9½ million acre strip there have been found 100 interesting structures, 62 oil fields which will make in excess of 20 million barrels ultimate recovery, 29 of which will make in excess of 50 million barrels, and 11 of which will make in excess of 100 million barrels.

If hopes based on the similarity of this geologic pattern are realized, the companies will make money unless:

- Existing tax laws are altered unfavorably.
- Royalties are made substantially more than one-eighth.
- Non-operating days on the high seas are numerous. (A major concern is demurrage on idle equipment. It costs $4500 a day to maintain a tender, platform and rig.)
- Producing characteristics of the sands are unfavorable. (It will be no surprise if some of the sands will prevent production of allowables.)
- Federal lease sales are held up.

Other Developments

Other developments concerning offshore operations last month included:

- The Department of the Interior issued a call for nominations for outer continental Shelf areas to be offered for leasing. Proposals for areas off Louisian are to be submitted by August 3, and off Texas by September 3. Interior will then select areas and offer them for competitive bidding. The agency plans to open Louisiana bids October 13 and Texas bids November 9.
- U. S. district court in Washington ruled that the Interior Department was correct in 1947 when it refused to consider applications for leasing offshore lands. Interior had concluded that offshore lands were not public lands and therefore were not subject to the terms of the Mineral Leasing Act of 1920. Had the court ruled otherwise, holders of state leases in disputed areas stood to lose them.

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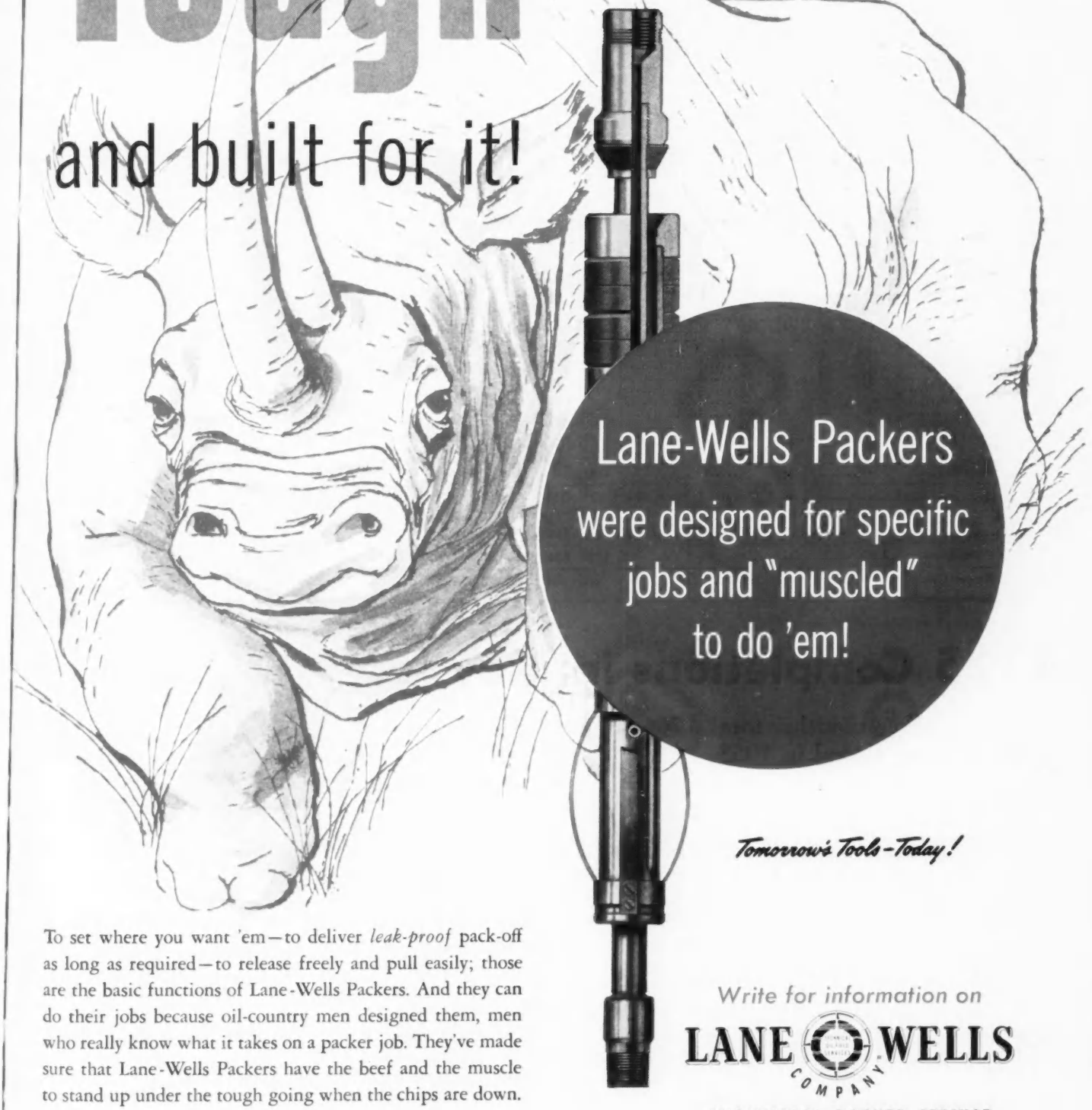

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AP-709

U. S. Wells Completed in May and First Five Months, 1954

STATE or DISTRICT	NEW WELLS COMPLETED AND FOOTAGE DRILLED																Rigs in Operation		
								TOTAL NEW WELLS				DETAILS FOR JANUARY-MAY							
												New Wells			Footage				
	Oil	Dist.	Gas	Dry	Water Input	Gas Input	Water Disposal	May, 1954	April, 1954	May, 1953	Total Footage May, 1954	1954	1953	Percent Diff.	1954	1953	May, 31, 1954	April 23, 1954	May 31, 1953
Alabama	2			9				11	7	7	54,411	37	39	— 5.1	188,132	209,208	5	5	6
Arizona									1	1		2	4	— 50.0	10,120	10,069	1	1	3
Arkansas	19		2	16				37	38	38	160,135	221	172	+ 28.5	792,560	613,183	31	36	28
California	147		1	50				198	209	200	838,525	1,084	1,045	+ 4.2	4,899,522	4,456,951	225	223	254
Colorado	45	1	10	57				113	118	52	622,007	512	218	+134.9	2,855,427	1,061,336	77	92	51
Florida				2				2	1	2	11,673	13	13		89,646	69,871	2	1	56
Georgia												3	3		11,068	7,808	3	3	3
Idaho													1	—100.0		12,720			
Illinois	150		2	133				285	241	175	748,287	1,140	714	+ 59.7	2,960,068	1,767,999	253	231	193
Indiana	17		1	41				59	64	94	99,746	324	489	— 33.8	498,232	873,354	124	123	148
Kansas	204		40	154			1	399	306	448	1,413,403	1,686	2,009	— 16.1	5,882,614	6,958,675	409	432	460
Kentucky	55		16	56				127	107	106	233,403	562	421	+ 33.5	1,071,625	833,987	96	93	92
Louisiana	184	20	18	64		1		287	225	185	1,843,620	1,336	968	+ 38.0	8,451,214	6,979,817	295	281	228
North Louisiana	109	7	8	24				148	124	73	456,215	696	399	+132.8	2,051,624	1,448,961	50	54	59
South Louisiana	75	13	10	40		1		139	101	112	1,387,405	640	569	+ 12.5	6,399,590	5,530,856	245	227	169
Maryland													2	—100.0		8,198	3		4
Michigan	25			25				50	27	53	131,178	234	225	+ 4.0	605,490	608,386	100	76	88
Mississippi	9	5	1	20				35	33	28	260,080	153	147	+ 4.1	1,061,618	1,033,383	36	31	32
Missouri				1				1	1	5	1,800	6	12	— 50.0	8,133	12,054			3
Montana	11			10				21	16	36	83,235	146	149	— 2.0	583,393	706,987	37	25	49
Nebraska	15		1					16	30	25	86,696	138	122	+ 13.1	762,336	632,026	23	24	15
Nevada									2			2	5	— 60.0	12,910	5,892	3	5	2
New Mexico	52	1	20	16				89	67	107	574,577	456	563	— 19.0	2,605,702	3,204,290	116	134	177
New York	27				18			45	54	72	63,163	278	353	— 21.3	387,450	493,311	78	85	108
North Dakota	7			8				15	24	22	100,467	97	97		683,532	763,904	32	27	34
Ohio	60		14	40				114	86	107	222,002	432	392	+ 10.2	842,577	819,863	187	193	179
Oklahoma	449	5	24	194			3	675	613	710	2,459,253	3,521	2,900	+ 21.4	11,883,080	10,448,279	729	754	578
Pennsylvania	34		18	7	32	5		96	91	147	169,381	486	639	— 24.0	841,241	1,113,476	213	223	259
South Dakota										1		10	3	+233.3	43,960	16,298	4	3	4
Texas	895	46	47	542	5			1,535	1,546	1,399	7,137,324	7,334	6,956	+ 5.4	33,630,396	31,666,639	1,372	1,354	1,371
Dist. 1: South Central	65	1	2	32				100	86	76	329,820	426	336	+ 26.8	1,471,537	1,092,927	41	36	30
Dist. 2: Middle Gulf	16	1	10	32				59	58	67	337,489	352	327	+ 7.6	2,091,571	2,004,240	53	41	46
Dist. 3: Upper Gulf	87	18	6	61				172	118	140	1,131,079	707	675	+ 4.7	4,824,570	4,530,521	146	114	131
Dist. 4: Lower Gulf-S.W.	51	11	6	55				123	151	149	641,200	633	786	— 19.5	3,277,035	4,465,650	87	99	114
Dist. 5: East Central	8		1	12				21	24	34	80,868	100	138	— 27.5	371,487	534,507	16	14	18
Dist. 6: Northeast	32	13	3	25				73	53	29	416,402	297	205	+ 44.9	1,806,737	1,200,486	43	56	40
Dist. 7-B: North Central	81		1	100				182	244	254	598,370	1,122	1,273	— 4.4	3,700,631	4,093,741	142	145	132
Dist. 7-C: West Central	74	1		29				104	113	114	532,849	522	597	— 12.6	2,630,708	2,996,594	143	141	138
Dist. 8: West	242	1	4	66				313	272	169	1,882,956	1,159	917	+ 26.4	7,021,246	5,181,613	355	355	348
Dist. 9: North	195		4	123	5			327	323	338	977,822	1,612	1,505	+ 7.1	5,106,993	4,970,784	252	256	304
Dist. 10: Panhandle	44		10	7				61	104	29	208,469	404	197	+105.1	1,327,581	595,066	94	97	70
Utah				1				1	5	5	8,934	18	32	— 43.8	108,447	189,979	19	15	15
Washington																	1		1
West Virginia	6		32	6				44	40	63	126,904	202	249	— 18.9	570,216	704,971	159	154	199
Wyoming	52			18				70	91	52	401,855	526	253	+108.7	2,755,588	1,248,559	83	85	103
Total United States	2,465	78	247	1,470	55	6	4	4,325	4,043	4,134	17,852,059	20,959	19,195	+ 9.2	85,096,297	77,531,471	4,716	4,709	4,693
Total Western Canada	67		8	48				123	162	127	517,192	782	767	+ 2.0	3,240,767	3,261,375	116	150	176

4325 Completions in May

Five-months' total 1764 wells or 9.2 percent ahead of same period in 1953.

THE INDUSTRY'S drillers hit their stride during May and completed 4325 new wells, a level not reached in record-breaking 1953 until August. This boosted the five-months' record to 20,959 new wells completed, 1764 wells or 9.2 percent more than the 19,195 completed by the end of May last year.

Total depths of May's completed wells amounted to 17,852,059 feet and that raised the year's total footage drilled to 85,096,297 feet. In five months the industry has drilled more hole than it did in entire years up until the end of World War II. Compared with active 1953, this year's footage gained 7½ million feet or 9.8 percent.

This year, each new well on the average has been carried to the total depth of 4060 feet. At the same time last year, each well averaged 4039 feet.

Of the five top drilling states, four have experienced sizable gains in this year's operations. No 1, Texas, saw new wells gain 5.4 percent from last year's 6956 to 7334. Its wells were also a little deeper on the average than they had been a year earlier. They have averaged 4586 feet against 4552, and although the gain was not great, the great number of wells and the fact that they are deeper than the national average have been quite important in the increase in the U. S. depth average.

Oklahoma, No. 2, upped its activity to complete 3521 new wells and that amounted to a gain of 21.4 percent over the 2900 drilled in the same five months of 1953. However, much of the increase has been concentrated in the state's shallower areas, for the average depth per well dropped from last year's 3603 to 3375 feet.

No. 4 state, Louisiana, hiked operations to include 1336 new completed wells, a gain of 38 percent over last year's 968 during the same period. However, much of the increase occurred in the northern district of the state where wells are generally much shallower than they are in the southern part. That resulted in the state's average depth dropping from last year's 7211 to 6326 feet.

Kansas, No. 3, was the lone exception to drilling hikes in the top states. Activity there dropped 16.1 percent from 2009 to 1686 wells.

WORLD OIL presents a detailed report about an area that has attracted the attention of oil men everywhere . . .

WILLISTON BASIN

The following pages of this special Williston Basin Section contain information on:

- **Development status and trends in the Williston Basin**
- **Map showing fields, county lines, principal towns**
- **General geology and prospects**
- **Taxes, laws, conservation measures, other oil regulations**

Other Williston Basin information of vital interest can be found in the Exploration, Drilling and Production sections of this issue.

WILDCAT DRILLING on a Montana location is evidence that . . .

Williston Basin Is Still A Challenging Frontier

Despite disappointments, both science and sentiment have led to the discovery of 66 oil fields and 4 gas fields in the area.

THE WILLISTON BASIN today is a frontier almost as challenging to the oil hunter as it was three years ago when it was opened with a string of wildcat successes which sparked one of the great oil plays of our time.

Only 44 wells had been drilled to pre-Pennsylvanian formations before 1951 in the vast area of the Williston Basin, estimated to cover from 100,000 to 150,000 square miles in North Dakota, South Dakota, eastern Montana, and Saskatchewan and Manitoba in Canada. A surprisingly active leasing play was under way by January, 1951, when Amerada Petroleum Corporation recovered the famous "pint of oil" in the Iverson 1 being drilled south of Tioga. In February, California-Standard Company completed a small producer near Virden in Manitoba and the following April, Amerada's Iverson flowed oil to spark a frenzied leasing play. Other strikes followed quickly.

The discovery year closed with 23 wells completed, three oil fields opened and millions of acres under lease. In North Dakota, for instance, acreage under lease went from 10 million to more than 28 million acres at the close of 1951.

What of Williston today? The early string of successes was broken by the inevitable dry holes but the basin's history has been impressive: 130 wildcats completed in 1952 to discover 28 oil and gas fields; 164 wildcats completed in 1953 for 23 oil and 2 gas fields; 113 were completed through May 15 this year for another six discoveries and a half-dozen successful wells which may be either discoveries or extensions.

In addition to these 66 oil fields and 4 gas fields, the Williston Basin has added the twenty-seventh and twenty-eighth oil producing states, North and South Dakota. There are more than 700 producing wells with commercial pay from 15 different horizons. Production averages about 30,000 barrels per day, far under potential if markets existed. Estimates of reserves range up to a billion barrels.

Despite handicaps of winter and bad spring thaw conditions, 81 rotary rigs were running at mid-May and more were being moved in as load restrictions on highways were lifted. While seismic activity has dropped from the peak of 124 crews during July, 1952, the basin counted 84 crews active in mid-May, about equally divided between North Dakota, Montana, and Saskatchewan. No crews operated in Manitoba, where geophysical activity came to an abrupt end in December, 1953. Most major companies in the basin have completed extensive seismic exploration until prospects are drilled, although as more control is established there is considerable reshooting in certain areas.

With less than 500 wildcats drilled in so large an area and a heavy percentage of those in Saskatchewan and Manitoba where drilling is shallower, it is obvious why the drilling density in North Dakota, for instance, was only one well to 375 square miles as 1954 opened. With large undrilled areas the rule, obtaining subsurface control has been difficult, particu-

larly in attempting to find stratigraphic traps on the flanks.

The seismograph has been the major exploration tool, with almost all major fields being found on seismic prospects. A majority of the successes in the U. S. portion of the basin have been on long-known structures, the Nesson anticline in North Dakota, Cedar Creek and Poplar anticlines in eastern Montana. Lack of success elsewhere, except for marginal pools opened in Bottineau County, North Dakota led many to believe the only important oil would be found on those anticlines.

Two discoveries in 1953 proved that oil could be found by the seismograph in areas where there are no surface indications of structure. Sun Oil Company and Phillips Petroleum Company opened Brorson field in Richland County, Montana, and Amerado discovered Fryburg field in Billings County, Montana, on purely geophysical data.

Biggest disappointment in the U. S. portion of the basin has been the lack of success on the eastern and southern flanks. Eight wells in Bottineau County are small producers and Shell Oil Company's South Dakota discovery in Harding County is on the southern end of the Cedar Creek anticline so these do not qualify for the flank fields which geologists are certain exist.

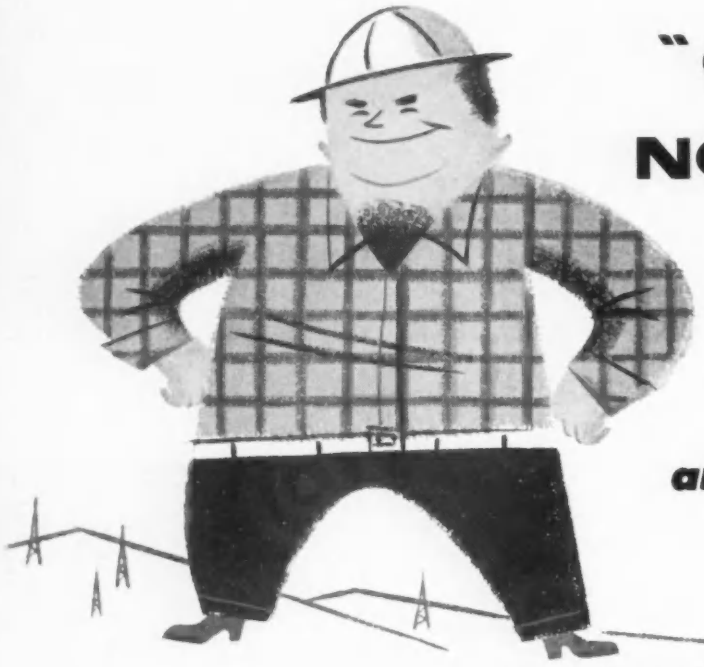
The Fryburg and Brorson successes last year helped turn attention to the deeper portions of the Williston Basin where a dozen or so wildcats were drilled in southwestern North Dakota and eastern Montana. Most of these were drilled on Grade A seismic prospects; most of them found varying shows of oil, but a lack of permeability and porosity for commercial accumulation. Two of the greatest disappointments were wells which recovered substantial quantities of free oil without water on drill stem tests, but when pipe was set and the lime acidized the recovery was almost all water.

Porosity varies so much that wells can be on structure and not produce as much oil as what appear to be edge wells. Again, fields can appear to be limited by edge wells only to find better oil a couple of locations farther out. In North Dakota, at least

A BASIN OUTCROP. The geology is complex, exploration problems many.

A WILLISTON PRODUCER in the Glendive pool in Eastern Montana.

MAIN STREET of Miles, Mont., a typical town in Williston Basin.



"OH, THE NORTH COUNTRY

is a rough country...

and it mothers a hardy brood!"

The Rocky Mountain Country is a rough country, too, for an oil well service organization to cover in the complete way Baker Oil Tools, Inc. does the job. Only a hardy, pioneer company, with a sincere desire to offer helpful service could stay in the Rockies under such adverse circumstances.

The terrain is rugged. Distances are great. These, together with the climate and the condition of the roads, make costs extremely high. In spite of this, Baker entered the Rocky Mountains, established a real organization, and ever since has been in a position to render genuine Baker Service, in addition to maintaining available stocks of Baker Tools.

Much credit is due the Supply Companies who went into the Rockies—and especially the Williston Basin—in the early stages, to make oil tools and supplies available under pioneering conditions. They, too, have been operating at far greater unit cost than holds true in other, more fully developed areas where less rigorous conditions prevail.

Any operator must admit that availability—whether of tools or services—is a definite convenience to him. And it takes support in the form of tangible orders to ensure the continuance of such availability anywhere.

When an operator needs Baker Service Tools and Baker Service for the completion of his well, he knows that Baker will come through for him. When he needs Baker products, such as Baker Casing Centralizers, Baker Wall Scratchers, Baker Cement Floating, Guiding and Cementing Equipment, he knows he can obtain them through his favorite Supply Store.

The point is this: The more operators specify Baker Products and thus support our continuing efforts to make Baker Products and Baker Service available to them, the better able we will be to maintain and expand our Service facilities wherever oil wells are being drilled.

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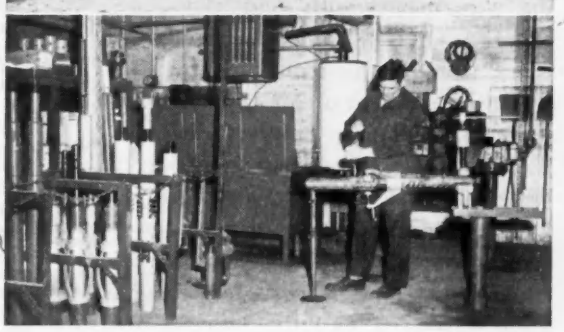

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two Nesson anticline wells once abandoned have been reworked to become producers although they have not yet proven they will pay out for the operators who took over the "dry" holes, spending $50,000 to $60,000 to set pipe and recomplete.

While the seismograph has located structural traps, it has not been successful on the flanks of the basin except in Canada. However, fields such as Daly are primarily structural, and the outstanding shallow field was located by sentiment instead of science.

This was Manitoba's Roselea field, drilled on a sentimental hunch by the McIvor brothers on the family homestead near Virden when a rig owned by the brothers was idle. They opened the first prolific shallow production in the basin; some Roselea wells being brought in for as much as 2500 barrels per day from the Mississippian at 2100 feet.

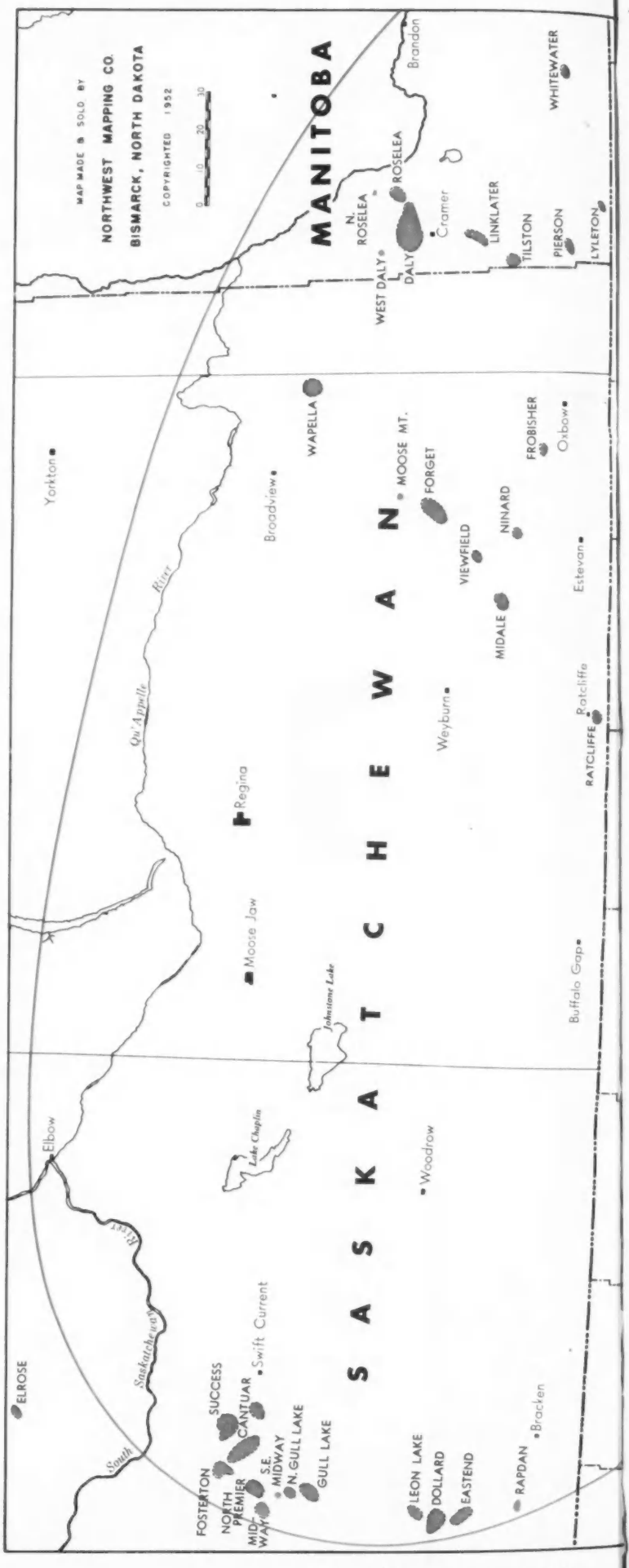
Roselea sparked an unprecedented Manitoba campaign; for the first time rigs ran all winter instead of folding up until spring. Discovered in July, 1953, Roselea in seven months had 26 producing wells with but one dry hole.

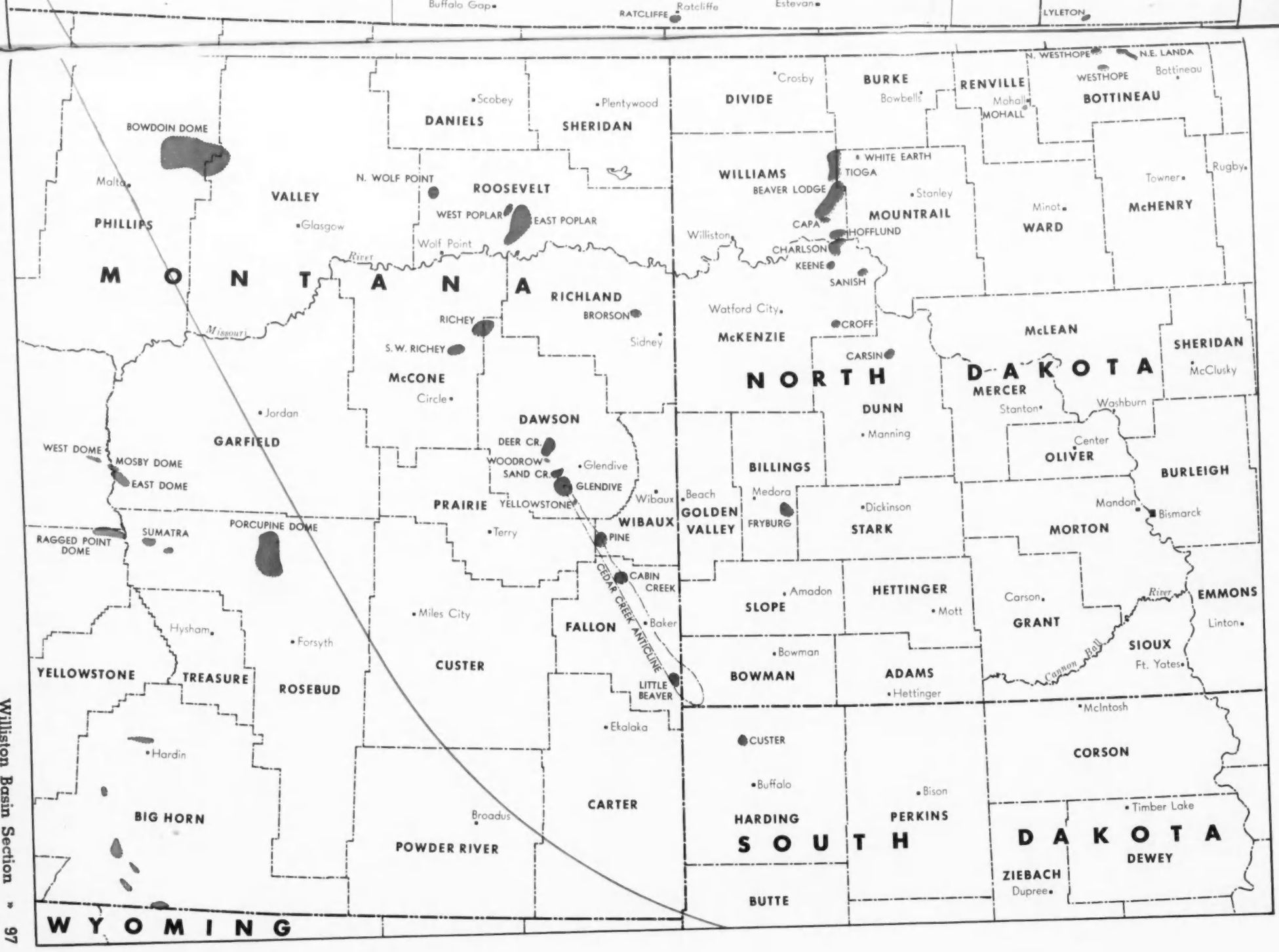
Manitoba's largest field is Daly, 10 miles southwest of Roselea. California-Standard's 1951 discovery was suspended within a short time, as was its confirmation, but by moving westward Daly field was opened. Daly's limestone is tight; after disappointing experiments with acid, shooting and fracturing California-Standard found fracture treatment the most effective. Just about all wells go on the pump immediately; however, several flowing wells have been completed south of what appeared to be edge wells. California-Standard has converted four wells to injection in an experimental water-flood, four have been suspended and the number of producing wells is nearing 100.

Except for North Roselea and several successful extension developments around Roselea, Manitoba's other fields have only from one to three producers. Waskada and Lulu Lake have been suspended because they became non-commercial with transport truck the only transportation.

Shallow discoveries in Manitoba have been the biggest spur to wild-

Williston Basin Oil and Gas Field Map

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Malta
PHILLIPS
VALLEY
Glasgow
DANIELS
Scobey
SHERIDAN
Plentywood
N. WOLF POINT
ROOSEVELT
WEST POPLAR
EAST POPLAR
Wolf Point
River
M O N T A N A
RICHLAND
BRORSON
Sidney
RICHEY
S.W. RICHEY
McCONE
Circle
Missouri
Jordan
GARFIELD
WEST DOME
MOSBY DOME
EAST DOME
RAGGED POINT DOME
SUMATRA
PORCUPINE DOME
DAWSON
DEER CR.
WOODROW
SAND CR.
Glendive
GLENDIVE
PRAIRIE
YELLOWSTONE
Wibaux
WIBAUX
Terry
PINE
CABIN CREEK
CEDAR CREEK ANTICLINE
Miles City
FALLON
Baker
Hysham
Forsyth
YELLOWSTONE
TREASURE
ROSEBUD
CUSTER
LITTLE BEAVER
Ekalaka
Hardin
BIG HORN
Broadus
POWDER RIVER
CARTER
WYOMING
DIVIDE
Crosby
BURKE
Bowbells
RENVILLE
Mohall
MOHALL
N. WESTHOPE
WESTHOPE
N.E. LANDA
Bottineau
BOTTINEAU
WILLIAMS
WHITE EARTH
TIOGA
BEAVER LODGE
Stanley
MOUNTRAIL
Minot
WARD
McHENRY
Towner
Rugby
CAPA
HOFFLUND
Williston
CHARLSON
KEENE
SANISH
Watford City
McKENZIE
CROFF
CARSIN
McLEAN
SHERIDAN
McClusky
N O R T H
D A K O T A
MERCER
Stanton
Washburn
DUNN
Manning
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SLOPE
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Cannon Ball
Bowman
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HARDING
Bison
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catters convinced that similar production can be found on the eastern and southern flanks in North and South Dakota. Despite the lack of shows outside of Bottineau County, wildcatters have continued to drill one dry hole after another in the conviction that drilling is the only way to find the stratigraphic traps they are certain exist. North Dakota has been the biggest benefactor of Manitoba's discoveries, for the oölitic Lodgepole limestone trend can be traced south.

Because comparatively little drilling has been done on the "east side," companies have been reluctant to drop acreage even under and offsetting dry holes. In North Dakota only 100,000 acres were released last year, while operators leased another 1.5 million acres to bring 32 million of the state's 44,834,000 total acres under lease.

Many east side wildcats have been drilled only through the Mission Canyon or Lodgepole in the Mississippian; with two-thirds of the possible sedimentary rocks untested and little pressure of lease expiration except for five-year state leases, companies do not yet dare drop much acreage.

Instead, they are offering more and better farm-out deals. The east side is the independent's country and will become more so, for not all of the Williston Basin is the blue-chip country of the deeper drilling in the central portion. With some majors having 2.5 to 3 million acres under lease, they are under increasing pressure to get as much possible evaluated. This year is expected to set a record for east side drilling.

North Dakota boasts the two largest fields in the Williston Basin—Beaver Lodge and Tioga. Beaver Lodge with more than 140 producing wells has been fairly well outlined by dry holes, but Tioga, with more than 130 producers, is still open at the north and northeast.

Prior to 1953 several pools had been opened south of Beaver Lodge, but discovery wells did not find oil in the quantity and quality of Beaver Lodge and Tioga. Late in 1953, however, The Texas Company completed a one-mile extension well in McKenzie County's Charlson, and additional drilling gives promise that Charlson may become a field of considerable size.

PROUD OF OIL is Poplar, Mont., as the lettering on the city water tower indicates.

Across the Missouri River in Williams County, Hofflund field also is developing better wells and geologists have not ruled out the possibility that the two fields may be connected. In fact, so unpredictable is the Madison limestone on the Nesson anticline, some are speculating that porosity zones may connect the entire string of pools.

Operators in Charlson and Hofflund with leases near the Missouri River face the probability of having to go into a marine operation of some magnitude sometime after this year when Garrison Dam begins backing up the Missouri for flood control and hydroelectric power. At the 1850-foot level planned by the Army Engineers, the pool will cover portions of the two fields to a depth of 50 feet. Directional drilling from high ground is being studied.

North Dakota has two producing sandstone pools, the only sand production in the U. S. portion of the Williston Basin. Stanolind Oil and Gas Company opened production in Sanish field, McKenzie County, in a basal Mississippian sand at 10,525 feet.

What is being called the Fryburg sand at the base of Pennsylvanian members is producing in one well at Fryburg field, Billings County, where the main pay is Madison. The Cheadle 1, an 80-acre offset, was unproductive in Madison so was completed in the sand. Production indicates a weak well with heavy oil of high pour point, limiting the thin sand section to salvage oil, according to present information.

East Poplar ranks as the best field in the eastern Montana portion of the Williston Basin, both in size of the field and wells. With more than 40 producers, apparently under water drive, the main field has been extended by wells outside the unit area. Murphy Corporation is operator, with Placid Oil Company and The Carter Oil Company also in the unit.

On Cedar Creek anticline, Glendive field appears to be small in area, but the wells should make profitable operation. Development in Cabin Creek is being accelerated after Shell's 1953 discovery reported the thickest potential oil pay of any well in the Basin, more than 1000 feet in the Madison, Silurian and Ordovician horizons. Calculated potential from Silurian and Ordovician on substantially open flow was reported as 4253 barrels of oil daily. It was completed in Ordovician for 244 barrels daily; development wells are also completed in Ordovician.

Development of Pine field indicates a promising field in Wibaux County, but many of the other fields appear to be small and marginal. Richey now is producing largely water.

Deepest producing well in the basin is the Brorson discovery. Development and extension drilling indicates the possibility of Madison production at 9125 feet in addition to Ordovician at 12,585 feet. The Dynneson 1 discovery was completed for 700 barrels of oil daily.

A deep Montana well with much less than that potential was completed on pump by Lion Oil Company in Wibaux County with production from Ordovician at 11,000 feet. This was the first success off the crest of the Cedar Creek anticline.

Shell put South Dakota into the oil-producing ranks by completing the State 1-A in Custer County for a pumping well from the Ordovician at 8587 feet. Initial production was

Workman pours 25 lb. bags of phenolic resin spheres into hopper.

Diagram at left shows system for introducing spheres into oil storage tank.

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At an oil station in Texas recently, it took less than an hour to install a covering of Microballoon*spheres on the oil in a 10,000 barrel tank. Half an inch thick, this floating blanket will cut evaporation loss 80-90 per cent.

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*Trade-mark Standard Oil Company (Ohio).

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80 barrels of oil and 200 barrels of water per day. A confirmation test has been put on pump; the discovery has sparked interest in the northwest corner of the state.

Saskatchewan came into its own as an oil province during 1953 after years of lagging behind Alberta and Manitoba. The Williston Basin area of the province helped roll up record statistics in drilling and discoveries, with the fastest development being in Fosterton, Gull Lake and Success fields, each with 40 to 50 wells.

The market problem has become acute for all the basin, particularly for Montana and Saskatchewan. Manitoba was unusually fortunate in having its two best fields within ten miles from a pumping station on the Interprovincial pipe line.

In North Dakota, development of Beaver Lodge and Tioga fields was pushed so rapidly that before the end of 1951, Service Pipe Line Company began laying a gathering system. The following year Standard Oil Company (Indiana) announced plans for a 30,000-barrel refinery at Mandan, and Service a scheduled trunk pipe line to serve it from the Tioga area. The pipe line, with 100,000-barrel capacity by adding pump stations, was completed last year as was a products pipe line to link Mandan with Standard's existing products line from Whiting, 200 miles east of Mandan at Moorhead, Minn.

Standard's refinery is scheduled to be on stream by October, when North Dakota will have a fully integrated industry. In addition, smaller refineries now are on stream at Williston and Dickinson to give the state about 35,000 barrels daily refining capacity.

Except for Brorson, where the gas-oil ratio is about 800 to 1, the Nesson anticline fields are the only oil pools in the basin with a substantial gas-oil ratio—about 1000 to 1. Signal Oil and Gas Company is completing a gasoline plant with throughput of 40 Mmcf. of gas daily. The plant will yield an estimated 150,000 gallons of natural gasoline and LPG and 40 tons of sulfur daily.

Proposals have been made for natural gas pipe lines to market the dry gas to eastern North Dakota.

Very discouraging was the recent decision of a group of 12 companies to drop studies for a big inch line to carry basin oil east to Minneapolis and Chicago.

Socony-Vacuum Exploration Company, Woodley Petroleum Company and Southern Production Company, chief operators in the Fosterton area, solved their problem by going to the Minneapolis-St. Paul, Minn. area. Great Northern Oil Company, with Woodley and Southern Production the chief owners, is building a 20,000-barrel refinery near St. Paul to be completed in 1955. Socony has contracted to deliver 20,000 barrels of Fosterton crude daily by the time the refinery is on stream and will build a pipe line from Fosterton to link with Interprovincial at Regina. The crude will be taken out either at the Clearbrook pump station in northern Minnesota or at Superior, Wis. Minnesota Pipe Line Company, organized by Woodley, will build a line to the St. Paul refinery.

Most Williston crude must move by rail at a corresponding disadvantage in field price to come close to competing with crude from other areas in the U. S. The rail rate from Tioga to Chicago, for instance, is $1.41 per barrel compared to an average of 38 cents per barrel for pipe line movement from West Texas, a comparable distance.

Completion of the North Dakota refineries will only partially solve the marketing problem for by that time production from already known fields will far exceed the 35,000 barrels daily. —**The End**

ACKNOWLEDGMENT

All photographs courtesy of The Carter Oil Company.

Oil and Gas Fields—Williston Basin

NORTH DAKOTA

NAME, DISCOVERY DATE, PRODUCING FORMATION	DEPTH
BEAVER LODGE, 1951, Mississippian (Mission Canyon)	8,500
Silurian, 1951 (No Wells Producing)	11,600
Devonian, 1951 (No Wells Producing)	10,500
TIOGA, 1952, Mississippian (Mission Canyon)	8,200
CROFF, 1952, Mississippian (Mission Canyon)	9,500
CHARLSON, 1952, Mississippian (Mission Canyon)	9,000
HOFFLUND, 1952, Mississippian (Mission Canyon)	8,675
WESTHOPE, 1952, Mississippian (Charles)	3,350
KEENE, 1953, Mississippian (Mission Canyon)	9,100
NORTHEAST LANDA, 1953, Mississippian (Mission Canyon)	3,075
EAST LANDA, 1953, Mississippian (Mission Canyon)	3,075
NORTH WESTHOPE, 1953, Mississippian (Charles)	3,250
FRYBURG, 1953, Mississippian (Mission Canyon)	9,400
EAST TIOGA, 1953, Mississippian (Mission Canyon)	8,375
SANISH, 1953, Mississippian (Sanish Sand)	10,525
CAPA, 1953, Mississippian (Mission Canyon)	8,325
RENVILLE GAS, 1953, Cretaceous (Shut In)	300
WHITE EARTH, 1954, Mississippian (Mission Canyon)	8,420
FRYBURG, 1954, Pennsylvanian ? (Fryburg Sand)	8,270
NORTHWEST TIOGA, 1954, Mississippian (Madison)	8,186

EASTERN MONTANA

RICHEY, 1951, Mississippian (Mission Canyon)	7,200
PINE, 1952, Ordovician (Gunton and Red River)	8,950
GLENDIVE, 1952, Ordovician (Gunton and Red River)	9,050
EAST POPLAR, 1952, Mississippian (Charles)	5,700
NORTHWEST POPLAR, 1952, Mississippian (Charles)	6,175
DEER CREEK, 1952, Ordovician (Red River)	9,900
LITTLE BEAVER, 1952, Ordovician (Red River)	8,500
WOODROW, 1952, Mississippian (Madison)	7,850
SAND CREEK, 1952, Silurian	9,000
SOUTHWEST RICHEY, 1952, Devonian, Silurian, Ordivician	9,100
NORTH WOLF POINT, 1952, Mississippian (Mission Canyon)	6,400
CABIN CREEK, 1952, Ordovician (Gunton and Red River)	8,650
BRORSON, 1953, Ordovician (Red River)	12,600
YELLOWSTONE, 1953, Ordovician (Red River)	8,775
NORTH RICHEY, 1954, Silurian	9,215
WOODROW, 1954, Ordovician (Red River)	10,000
WIBAUX, 1954, Ordovician (Red River)	11,000

MANITOBA

NAME, DISCOVERY DATE, PRODUCING FORMATION	DEPTH
DALY, 1951, Mississippian (Lodgepole)	2,450
TILSTON, 1952, Mississippian (Lodgepole ?)	3,100
WASKADA, 1952, Mississippian (Mission Canyon)	3,025
LYLETON COULTER, 1952, Mississippian (Mission Canyon)	3,200
LULU LAKE, 1952, Mississippian (Lodgepole)	3,300
ROSELEA, 1953, Mississippian (Lodgepole)	2,100
WHITEWATER, 1953, Mississippian (Lodgepole)	2,500
NORTH ROSELEA, 1953, Mississippian	2,100
WEST DALY, 1953, Mississippian	2,500
PIERSON, 1954, Mississippian	3,240
BEKKER, 1954, Mississippian	1,760
WOODNORTH, 1954, Mississippian	2,470

SASKATCHEWAN

FOSTERTON, 1952, Cretaceous-Jurassic (Roseray Sand)	3,100
MIDWAY, 1952, Jurassic	3,450
MIDWAY GAS, 1952, Jurassic	3,450
CANTUAR, 1952, Cretaceous-Jurassic	3,100
SUCCESS, 1952, Cretaceous-Jurassic (Roseray Sand)	3,200
EASTEND, 1952, Jurassic	4,700
WAPELLA, 1952, Jurassic Sand	2,300
RATCLIFFE, 1952, Mississippian (Mission Canyon)	6,350
FRONTIER, 1952, Jurassic	4,500
GULL LAKE, 1952, Jurassic	4,000
GULL LAKE GAS, 1952, Jurassic	3,200
SUCCESS GAS, 1953, Cretaceous (Roseray Sand)	3,075
NORTH PREMIER, 1953, Cretaceous (Roseray Sand)	3,400
FORGET, 1953, Mississippian (Mission Canyon)	4,000
JAVA, 1953, Cretaceous-Jurassic	3,300
RAPDAN, 1953, Jurassic	4,600
LOOMIS, 1953, Jurassic	4,575
LEON LAKE, 1953, Jurassic Sand	4,000
DOLLARD, 1953, Jurassic	4,600
MIDALE, 1953, Mississippian (Mission Canyon and Charles)	4,600
MOOSE, 1953, Mississippian (Mission Canyon)	3,950
FROBISHER, 1954, Mississippian (Mission Canyon)	4,650

SOUTH DAKOTA

CUSTER, 1953, Ordovician (Red River)	8,590

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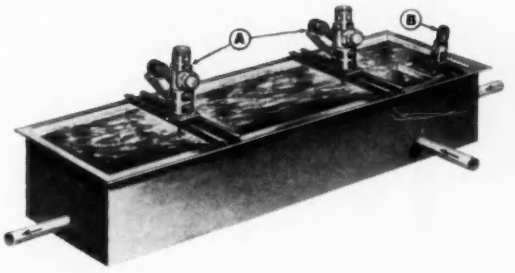

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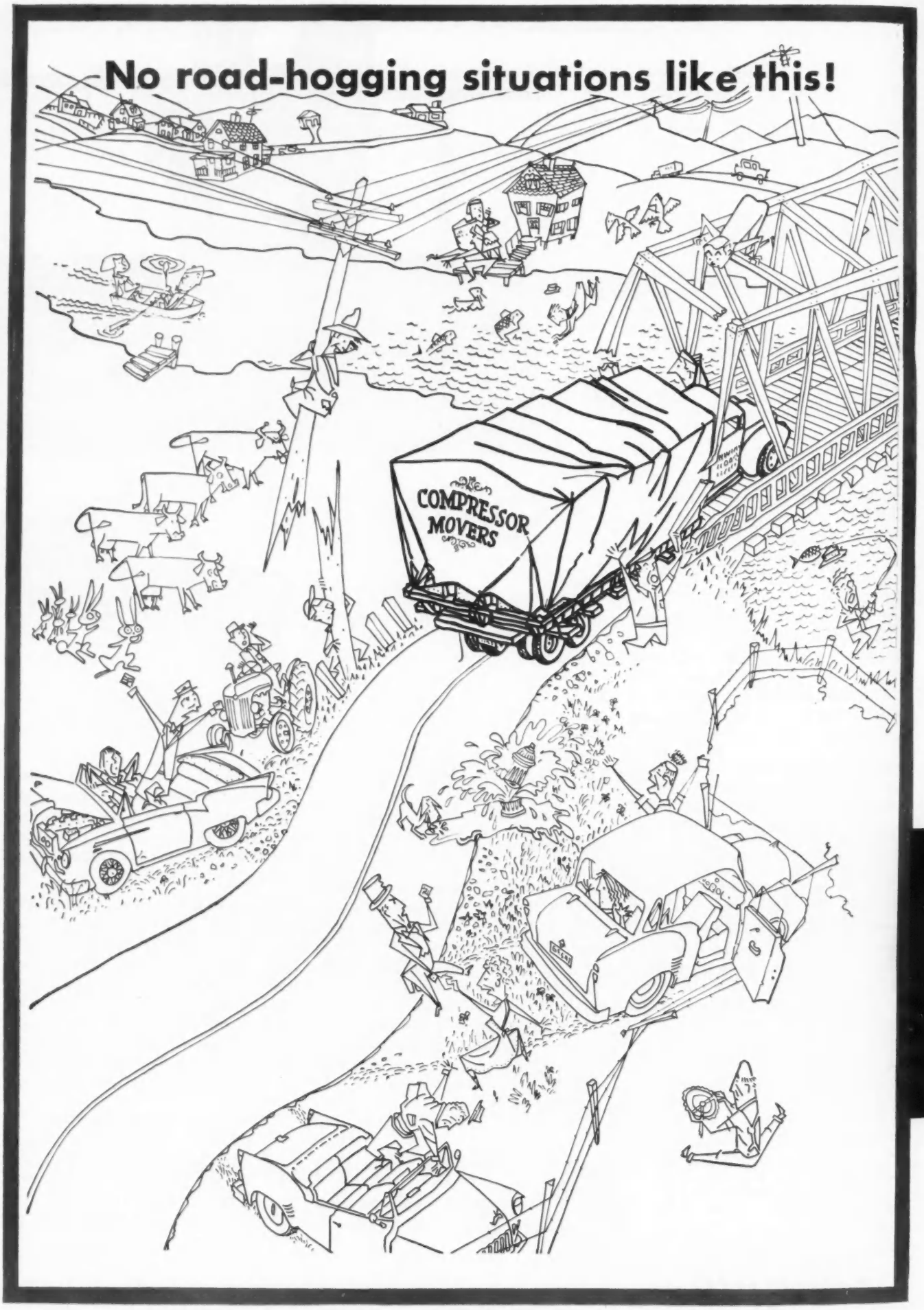
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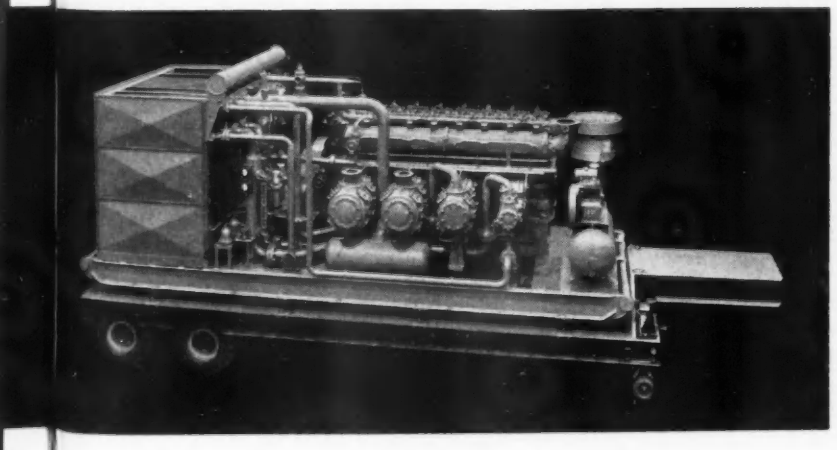

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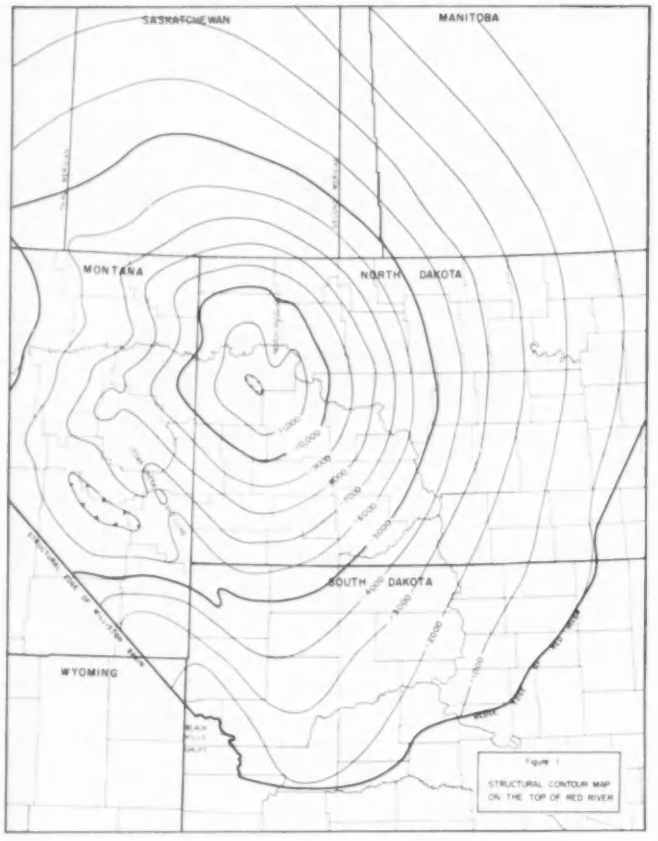

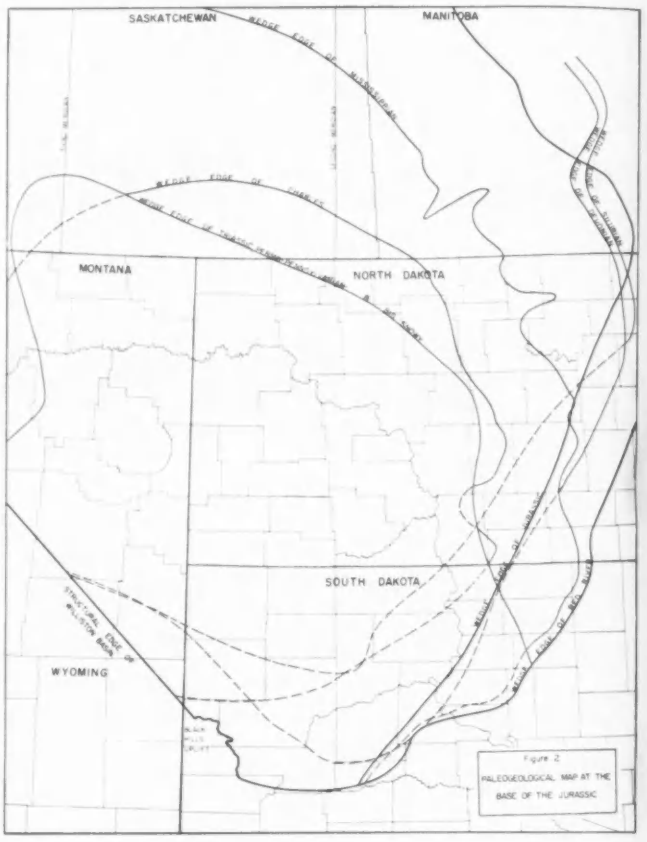

IN THE WILLISTON BASIN . . .

Geology Points to Major Oil Province

This vast area, 450 miles wide and 600 miles long, has all the needed geological qualifications. It currently is producing from depths of 1747 to 12,605 feet and has had oil showings at shallower levels.

By EDWARD L. MUELLER,
Consulting Geologist, Bismarck, N. D.

GEOLOGICALLY, THE Williston Basin is a proven oil province. It possesses all the geological factors necessary to make it a major oil producing area.

Oil is being produced from depths ranging from 1747 feet to 12,605 feet. Shows have been found at even lesser depths than the minimum oil producing depth (1747 feet).

Truncation wedge edges are present on all flanks of the basin and in sediments of all of the geological periods. These wedge edge features are at moderate depths and provide prospects of varying merit. It is conceivable that an "East Texas field" could be duplicated several times over in the Williston Basin.

The Williston Basin is a modern structural feature modified somewhat in common usage by the distribution of preserved sediments. It is eliptical in shape, centers near Williston, N. D., is approximately 450 miles wide on a northeast-southwest axis, and is about 600 miles long on a northwest-southeast axis. This basin is partially defined in Figure 1. Within this vast area we find remnants of sediments each of which was laid down in a depositional basin that was oriented in its own peculiar fashion and which did not necessarily conform to the present structural basin.

The orientation, size, depth, shape, and source of sediments for these ancient sedimentary basins is of utmost importance to the oil industry, since these factors are responsible for the lithology of a formation at any one place. The position of porous sandstones, reefs, clean porous lime-

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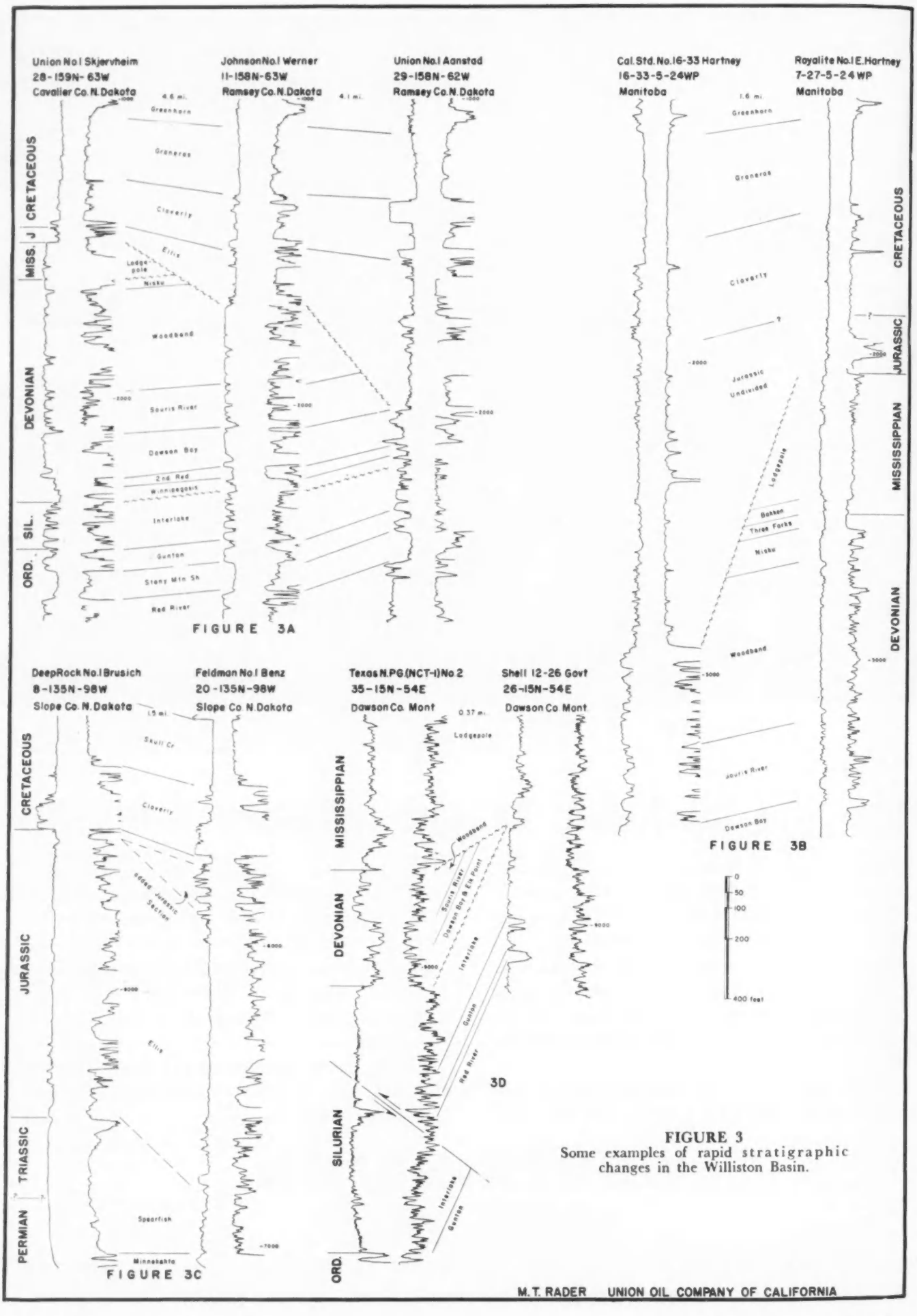

FIGURE 3
Some examples of rapid stratigraphic changes in the Williston Basin.

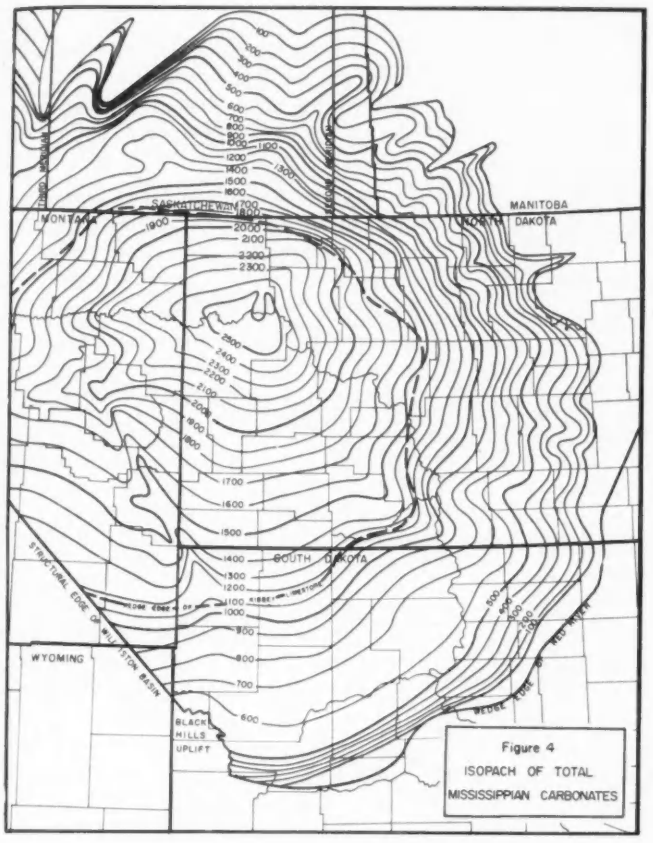

Figure 4
ISOPACH OF TOTAL
MISSISSIPPIAN CARBONATES

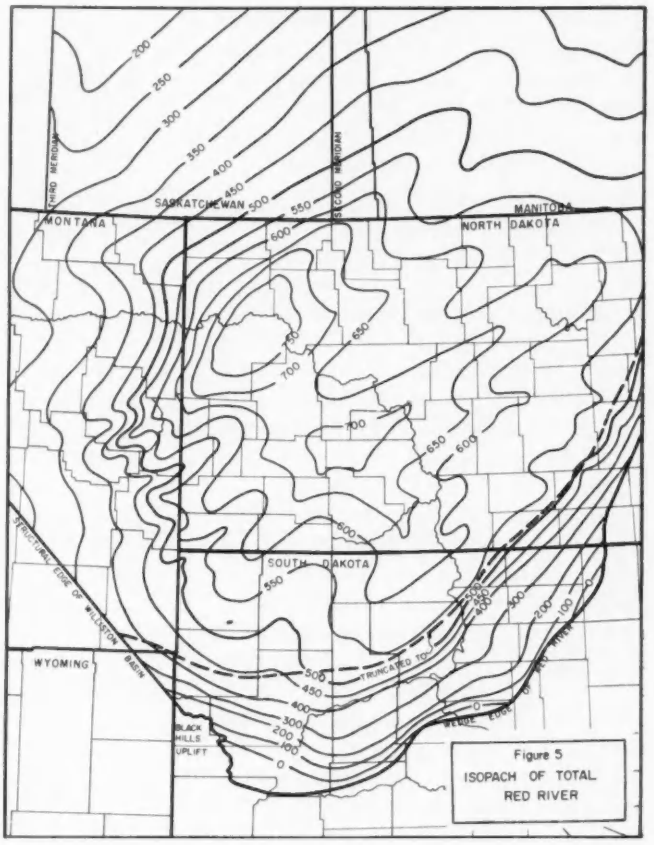

Figure 5
ISOPACH OF TOTAL
RED RIVER

stones, etc., in each rock unit can be anticipated as soon as a reasonably accurate idea of the depositional basin configuration for that rock unit is achieved. It is of course necessary to consider each formation individually to fully exploit the possibilities of this type of research. Present data are limited except in a few areas and do not allow for detailed studies of this type; however, the general framework of the basin for the various geological periods can be ascertained.

Cretaceous rocks within the basin vary in thickness from zero to in excess of 4000 feet. This variation is largely due to truncation, although considerable regional westward thickening occurs. The basal Cretaceous sandstones are universally present although erratically developed. The Muddy-Newcastle sandstone occurs in numerous areas and attains its maximum development in the southeastern portion of the basin. It is also generally well developed in much of the western part of the basin. The Judith River and the Eagle are prominent sandstones in the west and shale out east of the Cedar Creek anticline. The Cretaceous depositional basin oriented on a northwest-southeast trend has its axis far outside of the Williston Basin. Cretaceous trends are largely related to their own basin and are practically unaffected by the ancestral Williston Basin. The Judith River and the Eagle, plus some questionable basal Cretaceous sandstones, are already productive and the remaining sandstones are potentially productive over a large part of the Williston Basin.

Jurassic deposition followed deep erosion of the older sediments. The paleogeologic map, Figure 2, shows the Jurassic resting on the entire sequence of earlier sediments. The Jurassic, absent by truncation on the extreme eastern edge, varies in thickness from zero to in excess of 1200 feet within the Williston Basin. Again the major Jurassic basin was far removed from the Williston Basin, and Jurassic trends will conform to their depositional basin. It is interesting to note that in some areas practically the entire Jurassic is absent by nondeposition due to pre-Jurassic topography. This is demonstrated in the cross-sections, Figures 3A and B.[1] Present Jurassic production within the basin comes from sandstones and is to some extent stratigraphically controlled.

No attempt will be made to discuss the Triassic, Permian, Pennsylvanian or Big Snowy group of the Mississippian in detail. Although the stratigraphy of these sediments is still somewhat obscure, a thickness in excess of 1200 feet is achieved in their maximum development. Their distribution, indicated in Figure 2, represents only a small remnant of their maximum lateral development. Of these preserved sediments, the Pennsylvanian (Minnelusa and Amsden) appears to offer the greatest possibilities for oil in both sandstone and carbonate reservoirs.

The bulk of the Mississippian consists of carbonates plus minor amounts of evaporites and clastics. In its maximum development, the thickness of the section below the Kibbey limestone exceeds 2500 feet. These sediments now produce the bulk of Williston Basin oil, and an understanding of their depositional trends becomes essential. Isopach and lithofacies maps will assist in determining the most desirable areas for porosity, porosity pinchouts involving facies changes, reefs, and truncation wedge edges.

These elements are all present in the Mississippian and are critical factors in oil accumulation. Locally only the lowermost Mississippian sedi-

ments of this region are absent by non-deposition. In the Black Hills and in certain areas on the south and east flank of the basin, a maximum of several hundred feet of section may be absent by non-deposition over former weakly positive areas.

Pre-Mississippian erosion locally places the Mississippian sediments in contact with eroded Devonian, Silurian, and Ordovician. Truncation of the Mississippian carbonates is shown by the isopach, Figure 4, and only a small remnant remains of a very widespread Mississippian depositional basin.

Devonian sediments for the most part are carbonates, although some evaporites are present, and in their maximum development these sediments exceed a thickness of 2000 feet. A wedge edge due both to truncation and to non-deposition of the lower Devonian flanks the south and east side of the basin. Present Devonian production in the basin is found in structural accumulations. Reefing possibilities are indicated in the Dawson Bay and Winnipegosis formations, particularly along the south border of Manitoba. Again the Devonian exhibits evidence of its own depositional basin which does not coincide precisely with the present structural basin.

The Silurian, mostly carbonates, attains a maximum thickness in excess of 1000 feet, and apparently was subjected to pre-Devonian erosion over most of the Williston Basin. Silurian reefs are present on the outcrop near Lake Manitoba. Excellent porosity is developed locally in the subsurface. Both Silurian reefs and porosity due to pre-Devonian weathering make these sediments strategically interesting; however, present production is structurally controlled.

Ordovician carbonates attain a maximum thickness exceeding 800 feet. A Red River isopach, Figure 5, shows the bulk of this section and also gives some clue to the possible basin orientation at that time. The remaining Ordovician and Cambrian rocks are mostly clastic and attain a thickness exceeding 700 feet. This zone includes the Winnipeg sandstone, which is comparable to the Wilcox (Simpson) for appearance and reservoir characteristics.

This brief resume sketchily outlines most of the potentially productive sediments. As more data become available, detailed studies of each rock unit should provide the information necessary to find the most interesting structural and stratigraphic trends.

A number of geological events are known to be effective in the distribution of oil within the Williston Basin. Local and regional structural movements, unconformities producing remnants and wedge edges, alteration of porosity due to weathering, and the movement of fluids due to water entering the outcrop, are all factors in this problem. Source beds, although undoubtedly a factor, cannot be considered at this time.

The structural contour map on the top of the Red River, Figure 1, defines the pattern of regional dip over the basin for the remainder of the sedimentary section. Two very prominent structures modify the symmetry of the basin.

The Cedar Creek anticline, a well defined surface feature, is a northwestward plunging nose with fairly steep flanks. Southeast dip is critical for closure and to date subsurface control on this entire feature does not establish any structure with actual proven closure exceeding 300 feet.

The Nesson anticline is another prominent surface feature and is a southward plunging nose in which north dip is critical for closure. Cretaceous markers show a maximum of about 400 feet of north dip. Curiously enough, practically all of this closure is lost on horizons below the Jurassic. This is due to a rapid southward thickening of the truncated Triassic, Permian and Pennsylvanian sediments. Probably not more than 50 feet of reversal exists on the Mississippian horizons. Subsurface data are insufficient to demonstrate closure on deeper horizons, although it may be inferred from the known oil accumulations.

Drilling within the Williston Basin has not established the presence of structural closure in excess of 400 feet, and seismic structures with 150 feet of closure are considered grade "A" prospects. Although control is still extremely scattered and the data inconclusive, the conviction is growing that well developed structural prospects with an excess of 200 feet of closure will be rare. Although structures seem to be poorly developed, the presence of so many major unconformities would appear to indicate greater structural movement than has presently been found.

The most widespread and probably the most economically significant unconformity occurs at the base of the Jurassic. The potentially productive Mississippian wedge edges are largely a product of this period of erosion. More than 20 Mississippian oil fields, mostly in Canada, are either due to or are intimately associated with this unconformity. The paleogeologic map, Figure 2, shows the distribution of sediments below the Jurassic, and the Mississippian isopach, Figure 4, gives some indication of the deep erotion during that period. Figures 3A, B and C, give an idea of the canyon like topography present prior to Jurassic sedimentation.

Figure 3A is an electric log cross-section in Cavalier County in the northeastern part of North Dakota. In the Union Skjervheim 1, a very

About the Author

EDWARD L. MUELLER obtained his B.S. degree in geology at the University of Washington. He started his career in the oil industry as a seismic computor. Less than a year afterwards he joined Stanolind Oil and Gas Company and spent four years in the Permian Basin. After a short period in the company's Casper, Wyo. office, he transferred to the Williston Basin. After five years with Stanolind, Mueller became a consulting geologist with headquarters at Bismarck, N. D. In addition to consulting work, Mueller prepares for limited distribution a monthly report, "Analysis of Williston Basin Exploration," patterned along the lines of a major company confidential land and geological letter.

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incomplete Jurassic section overlies truncated Mississippian (Lodgepole), whereas in the Union Aanstad 1, eight miles away, the basal Jurassic is present, and truncation has penetrated deep into the Devonian.

Figure 3B is a cross-section of two wells only 1¾ miles apart lying about 35 miles southeast of Virden, Manitoba. Pre-Jurassic truncation has been very abrupt and deep, involving the loss of an additional 750 feet of section in the Cal-Standard Hartney 16-33.

Figure 3C is a cross-section of two wells only 1½ miles apart in Slope County, North Dakota, and in a "deep" part of the basin where pre-Jurassic erosion would appear to be a less likely factor. Even here the loss of section in pre-Jurassic sediments is sufficient to reverse the dip between markers above and below the unconformity. It is therefore readily apparent that valid seismic work will have to take this unconformity into account for deeper structural interpretations.

Much of the earlier seismic work leaned heavily on the Greenhorn (Cretaceous) and Piper (Jurassic) markers, since the quality of reflections on some of the deeper horizons were questionable. The loss of Triassic, Permian and Pennsylvanian section going northward on the Nesson anticline is the result of this unconformity, and it is also a factor in eastern Montana. Apparently this unconformity will be a significant feature over most of the basin.

Figure 3D is a cross-section of two wells on the Cedar Creek anticline in Dawson County, Montana, demonstrating pre-Mississippian truncation plus faulting on the west side of the anticline. Pre-Mississippian truncation is also quite extensive along the south and southeast flank of the basin. In the vicinity of Pierre, S. D., the Mississippian rests on Pre-Cambrian.

Other unconformities are present, but these geological events are not definitely associated with present production. Pre-Devonian truncation was very widespread but became most effective in the southern portion of the basin. The pre-Cretaceous inconformity shapes the east side of the Williston Basin by producing the Ordovician wedge edge.

Unconformities are also present in the subsurface at the base of the Minnelusa (Pennsylvanian), at the base of the Amsden (Pennsylvanian), at the base of the Kibbey sandstone (Mississippian), and at the top of the Charles (Mississippian). Several minor unconformities appear to be present within the Mississippian carbonates. There is evidence of an unconformity at the base of the Charles and of another at the base of the middle Mission Canyon dense zone as developed in the eastern portion of the basin. These minor unconformities are extremely significant, being intimately associated with producing horizons.

Since porosity may be either created or destroyed by weathering, the presence of an unconformity will materially affect reservoir characteristics of the underlying rock. Widely scattered areas of the basin have cavernous limestone porosity, and prolific production can be expected from reservoirs of this type.

A geological event of considerable importance in the Williston Basin is the movement of artesian water from outcrop areas. There are insufficient data at this time to properly evaluate the problem, although it should be taken into consideration on a Williston Basin play.

Production in basin has been obtained from sediments of all geological periods except the Tertiary, Triassic, Permian and Cambrian. The least promising prospect at present appears to be the Permian, although even those sediments cannot be entirely discounted. The Cretaceous has produced gas in commercial quantities for many years from the Cedar Creek anticline. Jurassic production, and perhaps also lower Cretaceous, is present in the Fosterton Area of Saskatchewan, with some additional Jurassic sand production in southeastern Saskatchewan.

The Pennsylvanian produces in the Fryburg Field in Billings County, North Dakota, and shows of oil have been found in it in other areas. The Mississippian produces in Montana, western North Dakota, southeastern Saskatchewan, southwestern Manitoba, and in a small area of the extreme north central part of North Dakota.

The Devonian, Silurian, and Ordovician have produced or carried commercial shows on both the Nesson and the Cedar Creek anticlines as well as on some other of the deep basin structures. It is readily apparent that a well drilled on structure in the Williston Basin in every sense of the word is potentially a multiple pay prospect.

Prospects for future field discoveries are dependent to a large degree on the availability of money for exploration. The Williston Basin is currently somewhat handicapped in the competition for risk capital both because exploration costs are slightly higher and because an adequate market for crude has not yet been developed. A better competitive position is in prospect for the foreseeable future since both exploration costs and the market situation are gradually improving.

A very sharp rise in wildcat drilling is evident for this year, reflecting improved operating conditions. Operators active in this area cherish the hope and the apparently reasonable conviction that their pioneering efforts in the Williston Basin will bring the anticipated large return on their time and money invested.

REFERENCE

[1] Miles T. Rader, geologist with Union Oil Company of California, generously assisted with his contribution of these cross-sections.

—The End

For other Williston Basin articles see . . .

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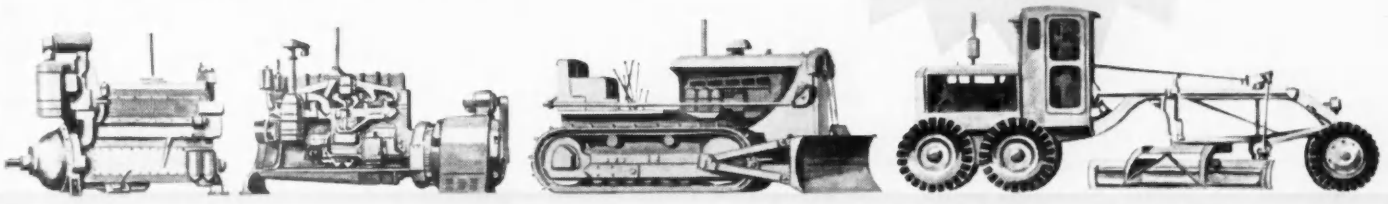

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North Dakota Oil Laws Encourage Operations

This new oil state, benefiting by lessons learned from other areas, built a good conservation law a decade before petroleum was discovered.

NORTH DAKOTA, a new oil state willing to profit from the trial and error lessons of older oil areas, has won wide praise for wise legislation and administration to encourage oil exploration and development.

That this has been accomplished in a state which prior to the 1951 discovery knew little more of oil than through its service stations, shows what can happen when the oil industry is willing to give facts to a people willing to learn. Eagerness of North Dakotans to learn about oil made public relations men out of every roughneck, every broker, every geologist; oil was taught to one or two people visiting a rig and to conventions of many hundreds.

Good law. Cooperation between North Dakota and the oil industry was made easier because a good conservation law was on the statute books a full ten years before oil was discovered. North Dakota was in the midst of a mild oil exploration boom when Dr. Wilson M. Laird, newly-appointed state geologist, approached the 1941 Legislature with a copy of the Interstate Oil Compact Commission's "model act." This was Dr. Laird's first experience with the workings of a legislature.

The state geologist found considerable opinion that North Dakota had no need of oil legislation and, at one point, the bill was killed. But when a couple of key legislators were convinced the bill could do no harm and might be desirable, it was revived and passed both House and Senate without a dissenting vote.

Thus, when oil was discovered ten years later, all the necessary machinery was in force, representing the best thinking of the men best acquainted with oil conservation at the time. The regulatory power was invested in the Industrial Commission, composed of the governor, the attorney general and the commissioner of agriculture and labor, with the State Geological Survey its administrative arm.

After the discovery, two important changes in rules and regulations were effected. A stratigraphic test was more clearly defined so logs, samples and other information would be filed with the state geologist for all except slim holes. The existing 10-acre minimum spacing rule was amended to 40 acres because of the deep drilling necessary in so much of the state.

Studies made. Between the discovery and the 1953 Legislature, exhaustive studies of oil and gas law were undertaken by a subcommittee of the Legislative Research Committee. Out of their studies and after numerous hearings with oil industry representatives and the people came four main pieces of legislation adopted by the 1953 Legislature:

- The 1950 Model Act of the Interstate Oil Compact Commission was substituted for the earlier law. Only one basic change was made: voluntary unitization was substituted for compulsory.

- A 4¼ percent gross production tax was imposed, with the ¼ percent earmarked for administration. Attempts to raise the tax were defeated.

- A 27½ percent depletion allowance was authorized for state income tax purposes.

- State income tax rates were reduced, largely in an attempt to compete for the oil exploration dollar.

The new conservation law and a measure authorizing North Dakota to join the Compact were passed unanimously by both houses. As a result of the new law, new rules and regulations were approved by the Industrial Commission December 1, 1953, after conferences with industry representatives.

One key provision of the new regulations relates to oil well spacing: it provides that a well drilled for oil shall be located not more than 160 feet from the center of a governmental quarter-quarter section or lot.

If a well discovers oil to open a new pool, the Industrial Commission will hold a hearing within 15 days after the discovery, issuing an order setting a temporary spacing pattern for the pool. This order is in effect for 18 months, when the commission must hold another hearing to consider all evidence pertaining to the physical characteristics of the pool, its geology and configuration.

Permanent spacing then is set for each pool. To date, temporary spacing has been on a wide pattern to help outline the pools. So far 80-acre spacing is in effect temporarily for most fields. Two have 40-acre spacing, and one has a 160-acre pattern.

Something new has been tried by North Dakota in an effort to divorce spacing from proration. The 1953 law provides for market proration—a rarity in the Rocky Mountain region. In prorating production to market demand, North Dakota regulations make a 40-acre tract the basic unit allowable. A pool with 80-acre spacing gets double the allowable; one with 20-acre spacing would get half the allowable.

Intent of this provision is to encourage scientific development but to assure the royalty owner an income independent of the number of wells on a 40-acre tract.

Another provision makes an allowance for producing depths and the increased costs of deep drilling. The normal unit allowable is set for a well below 5000 feet drilled on 40-acres. Below 5000 feet allowables are increased in the following proportions:

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11,000 to 12,000 ft.	5.67
12,000 to 13,000 ft.	6.75

Thus, if the basic unit allowable is 20 barrels, an 8500-foot well in a pool with 80-acre spacing would have a daily allowable of 120 barrels.

One important amendment has been made since the rules were adopted: Operators seeking shallow production complained that the depth factor was a handicap; they sought and obtained relief in a discovery allowable for all new pools regardless of depth. This awards to the first four wells in a new pool a maximum daily allowable of 200 barrels, if production does not result in waste. The discovery allowable is in effect for 18 months after completion of the first well or until completion of the fifth well, whichever is first.

Wells having a gas-oil ratio in excess of 2000 cubic feet per barrel are penalized in accordance with the amount by which they exceed this limiting figure, and allowable also is adjusted for wells producing from tracts more or less than 40 acres.

Mechanics of setting the allowable production, policing, and the basic drilling, plugging and production rules are much the same as in other oil states.

Drilling bond. Before drilling a well, an operator must provide a drilling bond of $2000 for one well or $10,000 for all drilling contemplated, an application to drill with a $25 permit fee and a certified plat by a registered surveyor of the proposed location. A notice of intent to drill must be filed, giving proposed depth, if known, elevations and the proposed casing program, and a report on company organization is required.

If drilling results in a producing well, a completion report giving testing, casing and other data must be filed. If it is a dry hole, a plugging report is required.

Production reports must be filed on or before the fifteenth of the month; reports also are required for gas production; a producers certificate of compliance and authorization to transport oil from lease, a gas-oil ratio report, reservoir pressure tests, transporters and storers monthly reports. Reservoir surveys are required twice yearly.

All applications and reports are made to the State Geologist, University Station, Grand Forks, N. D., where copies of the rules and regulations can be obtained. There, too, are filed logs, samples, cores and other data required by law. If requested, the information is withheld for six months. —**The End**

The Big Moment . . .

for Tom Leach

FROM A DREAM a quarter of a century old, a singularly resolute will and a pint of oil was wrought the Big Moment in the career of Tom Leach of Tulsa, Okla., and Bismarck, N. D.

Tom Leach

For it was a blending of these that led to the discovery of the Williston Basin, the latest spectacular oil frontier in the U. S., and to the forging of Leach's crown as "King of the Williston Basin."

Now a big-time operator in the basin, Consulting Geologist Leach recently formed a new company, North American Royalties, Inc., which owns 86,000 acres of mineral and royalty interests in lush basin areas. He and his wife, Frances, own about that much more royalty and more than 150,000 acres of leases, as well.

But it was back when he was surface geologist for Transcontinental Oil Company that he was sent to the Williston area or other business and noticed indications of promising structures. He later resigned from Transcontinental, in 1930, and went into business for himself as consulting geologist and oil producer.

The "King" made several good strikes in Oklahoma. But the north country beckoned always and he "gave in" in 1936, and returned. A second look did not qualify his initial impression as to the "good" geology, and he and an associate up and leased a quarter of a million acres.

Leach made a deal with Standard Oil Company of California. The well was dry. But that didn't stop him. For the next several years, he kept plugging away, the target of a lot of ribbing while trying to sell Williston to the industry singlehandedly.

During this often pessimistic, seldom optimistic effort, even Leach, stalwart as ever in his evaluation of the basin, had pinpricks of doubt. He once remarked to a friend:

"There's oil in the Williston Basin, but I wonder if I'll live long enough to see it."

Then destiny took a hand. There was oil in the Williston. And Leach did live to see it.

For in the fall of 1950, Amerada Petroleum Corporation recovered a single pint of oil on a test drilled on the Nesson anticline of Williams County, North Dakota. In April, 1951, Amerada released data on successful tests which revealed the North Dakota wildcat had commercial production. And the state was added to the list of U. S. producers.

The oil industry was startled. But not Tom Leach. He may have wondered if he would live long enough to see it, but he never doubted there was oil in the Williston Basin.

The "King" had been crowned.

Photo courtesy C. R. Dreher, Beach, N. D.

BADLANDS topography in certain areas of the Williston Basin poses serious exploration problems.

IN THE WILLISTON BASIN . . .

Exploration Problems and Procedures

The problems are based on the lack of real knowledge regarding oil accumulation. The answers can only come through extensive drilling and careful analysis of each well.

By RICHARD A. POHLY, Pohly Exploration Company, Tulsa, and
STEVEN H. HARRIS, Harris & Brown, Bismarck, N. D.

IN THE 3½ years since commercial oil was discovered in the Williston Basin in February of 1951, geological and geophysical work have been going on at a feverish pace. In reviewing the many excellent papers which have been published on single phases of this exploration, one is sharply impressed by the fact that no single present exploratory tools provides an adequate means for exploring new territory.

It will be the purpose of this paper to emphasize that in the development of any area all geophysical methods are strongly dependent not only upon other methods, but also on subsurface information as provided by the drill. This interdependence and the ability of one geophysical method to provide necessary information for another has been very much neglected in past literature. Nowhere has it been more strongly indicated than in the present concentrated attack on the relatively virgin Williston Basin.

Geographically, the Williston Basin occupies western and central North Dakota, with the adjoining portions of South Dakota, eastern Montana, southwestern Manitoba, and southern Saskatchewan, and comprises roughly 180,000 square miles. This vast province has been divided into two separate areas by glaciation, and since the exploratory problems differ in the two areas, the application of exploratory tools will be discussed under these two divisions, with the dividing line falling roughly along the present course of the Missouri River.

EXPLORATION METHODS

The various geophysical and geological tools which have been employed in the Williston Basin will be described generally and briefly. Their application to the exploration program will be evaluated and discussed in some detail under the subheadings of *unglaciated area* and *glaciated area.*

Surface Mapping. Surface mapping consists of identifying continuous beds in outcrop and measuring, either by altimeter or plane table and alidade, the relative elevations. It is one

Photo courtesy Shell Oil Company

TRANSPORTATION and shot hole drilling difficulties increase exploration costs in the Williston Basin.

of the oldest tools of the geologist and probably has resulted in more discoveries than any other single method.

It does, however, depend strongly upon seismograph or drill information to indicate whether the mapped surface structures continue downward to productive horizons.

Photogeology.[3] This method should probably be included in surface mapping, since it is simply a photographic refinement of that method. It does, however, provide a tool which can cover large inaccessible areas very rapidly by mapping continuous beds which can be identified on aerial photographs.

The differences in elevation of these beds are determined by photogrammetric methods. It has the same dependence upon seismograph and drill information as mentioned in the previous paragraph.

Magnetics. The magnetometer has been employed for many years as a reconnaissance tool for outlining basins and indicating localities where granite ridges and igneous intrusives may affect the sedimentary beds. Magnetic maps, however, reflect not only the proximity of materials with high magnetic susceptibilities, but are also influenced by polarity changes deep within the pre-Cambrian.

The method is therefore highly dependent upon additional information from gravity meter or seismograph to differentiate the probable source of the magnetic anomaly. Both surface and aerial magnetic surveys are available.

Gravity. The gravity method has been useful over a period of many years, not only as a reconnaissance tool, but also for detailing reefs and structures where sharp density contrasts are present between adjacent formations. It lacks uniqueness of interpretation and requires additional information from seismograph and drill holes. It can provide very helpful information when correlated with magnetic surveys. It is also extremely helpful in indicating salt thickness in areas where erratic salt beds may distort deep seismic reflections.

Seismograph. The seismograph is accepted as the most accurate geophysical tool available in mapping subsurface beds. It is, however, strongly dependent upon accurate subsurface and velocity information. In many areas, gravity can provide very useful indications of these velocity changes where drill holes are scarce.

Core Drill. In areas where structure affects most of the beds of the sedimentary section, and easily identifiable continuous beds are present at relatively shallow depths, the core drill provides an excellent exploratory tool. It has some of the same problems as surface mapping, such as continuity of beds, difficulty of correlation, etc., and in most areas requires the use of seismograph to determine whether the structures mapped continue down to productive horizons.

The use of slim holes has rapidly gained favor in many areas as an extension of the core drill method to test the downward continuation of structure to productive depths.

UNGLACIATED AREA

Surface Mapping. In the unglaciated areas, west and south of the Missouri River, surface mapping, both by altimeter and plane table and alidade, has been a valuable geologic tool. Early workers pointed out the existence of such major structures as the Cedar Creek anticline, Nesson anticline, and Popular Dome, and mentioned the possibility of oil accumulation in these features. Subsequent detailed surface mapping, seismic work, and drilling have verified both the existence of the structures and the presence of petroleum in commercial quantities. It should be noted that practically all of the present oil fields in the unglaciated portion of the Williston Basin are on surface anomalies.

From a theoretical standpoint, there are several factors which tend to oppose the extensive use of field parties for detailed structural work. First, there is a serious correlation problem. The surface exposures, for the most part, are of Tertiary and Upper Cretaceous age. Coal and bentonite beds are common and are usually used as key horizons. Although it is sometimes possible to trace a given marker for many miles, it is often difficult to map individual beds for appreciable distances and in many instances a series of marker horizons,

referred to a base plane, are used. The problem of finding the mappable key bed is often quite difficult, and miscorrelation of individual horizons, especially lignites, from outcrops to outcrop is always a possibility. In certain areas, there is serious doubt whether individual lignite beds are continuous over wide distances.

Another problem to be reckoned with is the presence of slump features in the outcrop area. Streams in the region under consideration are often deeply entrenched in the soft shales, silts, sands, and coals of the surface formations. Large scale slump and slippage features due to the deep stream valleys and incompetence of the surface beds are quite common, often unrecognized, and may times mistaken for true structural deformation. In the bad land areas large scale slippage with little tilting or distortion often occurs and may give erroneous elevation data. Where sand lenses are thick and unconsolidated, slumping invariably occurs. In addition, burned coal beds and the associated scoria horizons may cause slumping on a smaller scale.

A third theoretical problem is the relationship of surface beds to the major unconformities of the area. All oil fields in the unglaciated portion of the Williston Basin are productive in Paleozoic reservoirs, while the major unconformities are post-Paleozoic in age. It is considered problematical as to whether certain of the smaller surface anomalies continue with depth.

In spite of the aforementioned handicaps to field mapping, it should again be emphasized that many of the present Williston Basin oil fields are located on surface structures. The fact that many of these mapped structures were later verified by geographical means is impressive. Competent surface parties are the cheapest and quickest way to obtain local structural information, and in the area outside of the limit of glaciation, it is felt that surface mapping is a valuable reconnaissance tool which should be used prior to seismograph operations. The field season in the Williston Basin runs from June to November; whenever possible, aerial photographs should be studied before surface mapping is commenced.

Photogeology. Two objections to surface mapping, already discussed, are applicable to photogeologic interpretation: the presence of large scale slump features and the relationship of near-surface formations to major unconformities. Photogeology is a rapid and inexpensive way of reconnaissance exploration and may be used to furnish both regional and specific leads. In all instances, aerial photo mapping should be followed by detailed surface or geophysical studies.

Aerial photograph examination is extremely helpful prior to the employment of field parties. Field geologists can study in advance the terrain and other problems that must be taken into consideration. Drainage patterns, changes in soil and vegetation, and flat dips, difficult to observe on the ground, but sometimes indicative of structural conditions, often become readily apparent on the photos. Large areas can be examined quickly, and features of geological importance can be pinpointed for subsequent examination on the ground.

Magnetics. There is considerable question regarding the value of magnetometer surveys in the unglaciated portion of the Williston Basin. Wells drilled to the pre-Cambrian have shown considerable variation in the lithology of the basement rock, and to date there has been very little conclusive proof that magnetic highs are coincident with features in the pre-Cambrian surface which control structure in the beds above. Anomalies indicated by magnetic surveys should therefore be checked with gravity before more expensive investigation is planned.

Gravity. Gravity surveys in the unglaciated area have been used as a reconnaissance tool to provide localized features for detail with seismograph, surface mapping, or core drilling. In much of the unglaciated area, however, rough topography and difficulty in making accurate topographic corrections, poor control resulting from inaccessibility, and local near-surface density changes tend to invalidate much of the data.

The method has, however, indicated pre-Cambrian highs, Paleozoic structure, and erosional highs in the Paleozoic surface where near-surface effects were not too pronounced.

Seismograph. The seismograph has been used extensively in the unglaci-

SEVERE WINTER conditions contribute to exploration problems in the basin.

Photo courtesy Shell Oil Company

ated portions of the basin, not only as a reconnaissance tool, but also to check structure indicated by surface features. It has been very successful in most localities, in spite of a number of very serious problems. Burg,[2] Kornfeld,[5] and O'Malley[6] have published detailed accounts of these problems, and space limitations of this article permit only a brief mention of major problems.

Clinker beds in the Ft. Union provide a serious problem wherever they are present, since they not only cause lost circulation in drilling shot holes, but also tend to disperse the energy of returning waves. Poor records are almost universally associated with these beds.

Another serious problem is encountered in the unglaciated area where old Tertiary stream valleys have been subsequently filled with low velocity material. This condition, encountered in many areas of South Dakota, southwestern North Dakota, and eastern Montana, has the effect of showing drainage patterns in all horizons. Up-hole velocity surveys in deep shot holes and the use of multiple geophones have helped considerably in eliminating some of these effects. As more is learned about the local velocities of the Tertiary and Upper Cretaceous formations, the seismic surveys will more accurately may the deeper structures.

Core Drill. Since the core drill is normally used in the same manner as surface mapping in areas where outcrops are insufficient to provide the necessary continuity of information, the application of core drilling to the unglaciated parts of the basin has been negligible. Slim hole drilling could be useful to provide information about the downward continuation of shallow structure in local areas where seismic records are inconclusive.

Recommended Practice. The proper exploratory approach to the unglaciated portions of the Williston Basin should begin with a careful examination of the area, using photogeology and surface mapping. Reconnaissance gravity and magnetic surveys should be used to indicate structure below the unconformities which might not be evident in the surface beds. The gravity surveys should also be very helpful in ruling out some of the psuedo-structures indicated by surface mapping. This should be followed by detail reflection seismograph or slim hole drilling wherever favorable structure is indicated.

GLACIATED AREA

Surface Mapping. Within the glaciated area, east and north of the Missouri River, even though the till is generally relatively thin, local deposits in excess of 800 feet are known, and outcrops are seldom frequent enough for surface mapping. However, the glacial mantle has been stripped from the surface bedrock in restricted areas, and surface mapping can be attempted locally. Tilted bedrock exposures have been noted in some of these areas, and although true structure may be indicated, surficial deformation contemporaneous with glacial or post-glacial adjustment of near-surface formations should not be overlooked.

Photogeology. The scarcity of outcrops and the lack of homogeneity in the drift provide almost insurmountable problems for this method. It is probable that unless drainage systems or vegetation patterns can be found to be indicative of structure, the method will be of little value in this portion of the basin.

Magnetics. Reports of at least three magnetic surveys, which have been conducted by the North Dakota Geological Survey, have been published and appear to rather meaningless structurally. The sensitivity of the instruments and the contour interval chosen for the maps were, of course, not intended for structural detail. However, wells which have been drilled to date on magnetic highs have encountered sharp changes in the lithology of the pre-Cambrian rather than structure.

An added difficulty in the glaciated portion of the basin is the distortion produced by local accumulations of magnetic materials in the glacial drift. The investigation of magnetic anomalies in this area has been insufficient to be conclusive, but the interpretation problems already encountered indicate that the magnetometer must be considered only as a preliminary reconnaissance tool.

Gravity. The drilling in the glaciated portion of the basin has been entirely inadequate for evaluation of the gravity meter as an exploration tool. However, from a theoretical standpoint, the area provides an excellent field for gravity exploration.

In the deeper parts of the basin where seismic interpretation is seriously affected by variations in the thickness of the salt beds, gravity can be of considerable help. Locally thick salt beds, because of their high velocities, produce anticlinal features in the seismic maps of deeper horizons. Yet these same salt beds, being of low density, will produce gravity minima. Hence, when gravity minima coincide with structural features on seismic maps of pre-Mississippian beds, salt effects should be considered present.

The most important use of gravity will probably be in mapping reefs. The published descriptions of Devonian and Silurian reefs[2] encased in carbonate rocks makes a rather discouraging picture for the geophysicist. However, it must be remembered that very few wells have actually penetrated Devonian and Silurian reefs, so that no accurate evaluation of the relative densities of the reef and surrounding rock are available. It has been found in the other reef provinces of the world that the reefs and their environs have exhibited unexpected lithologic characteristics accompanied by sharp changes in density. Many gravity anomalies similar to those which are associated with the Illinois, Indiana, and Ontario reefs[7] are known to be present in this area, but as yet, none has been checked with the drill.

In the area where the truncated Devonian and Niagaran beds are overlain by the Triassic beds, erosional remnants should produce gravity anomalies. Whether differential compaction would produce structure in the Mesozoic beds over these features has not as yet been definitely determined.

Gravity surveys in conjunction with magnetometer should provide reliable indications of pre-Cambrian ridges along the shallow east flank of the basin.

The principal problems in gravity surveys in the glaciated area involve the low density till in Tertiary stream channels as well as variations in the drift itself. For the most part, the anomalies produced by these factors can be identified by the characteristic patterns, and where questionable can be checked by core holes drilled to bedrock. At the present time, the

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greatest deterrent to gravity surveys is the indefiniteness of interpretation. This will be corrected eventually, as additional subsurface information provides a better knowledge of density distribution below the surface.

Seismograph. The seismograph problems in the glaciated area are similar to those described for the unglaciated area. However, the drift itself provides a serious problem in variable velocities and absorption of energy. For the most part, however, conventional up-hole and refraction weathering corrections, plus supplementary data from long refraction shots, have been adequate to secure useable information in most parts of the glaciated area.

Core Drill. It is probable that the use of core drilling as an exploration tool will continue to increase in the Williston Basin, in spite of definite limitations, since it can provide a great deal of information not only regarding shallow structure, but also regarding drift thickness and composition. When electric logs are run, valuable information regarding the Tertiary and Cretaceous beds can be obtained which will assist in the correction of seismic data.

In the shallow eastern flanks of the basin, slim hole stratigraphic tests should be a particular aid in providing density and velocity information, as well as being a possible direct oil-finding tool. In the deeper portions of the basin, core drilling will continue to be of uncertain value in mapping any features below the major unconformities until more information is available regarding the younger structures and the effects of topography at the unconformities.

Recommended Procedures. In considering an exploration program for the vast glaciated portion of the Williston Basin, it is readily apparent that all of the geophysical and geological tools described in this paper must be used to provide important data, and the geologist or geophysicist responsible for the final interpretation must select from each method clues which will help to solve problems encountered by the other methods in order to arrive at an accurate evaluation.

To secure these data, it would be recommended that the magnetometer and gravity meter be used as reconnaissance tools to cover broad areas, and anomalies indicated by these methods should be followed by detail with seismograph, core drill, or slim hole drilling. Space does not permit mention of all the possible combinations to be derived from this approach, but a few of the more apparent uses should be mentioned.

Wherever magnetic and gravity maxima coincide, pre-Cambrian structural features are likely to be present and should provide worthwhile seismic prospects.

Where gravity maxima occur and are not associated with magnetic maxima, it is probable that the anomalies are produced either by topography at the unconformities, or by reefs. These anomalies should also be checked by seismograph.

Where deep structure is indicated by seismograph and is coincident with a gravity minimum, thickening of the salt beds is suggested.

Where gravity maxima coincide with seismic indications of Paleozoic structure, it could be true structure or indication of a topographic feature at the unconformity, and slim hole drilling would be recommended.

About the Authors

RICHARD A. POHLY attended Albion College and the University of Michigan from 1931 to 1935, where he majored in electrical engineering. This training was later augmented by extension courses in geology and geophysics from The Pennsylvania State College and the University of Texas. In 1937 he was employed by Shell Oil Company in the research division of the Geophysical department. Since 1941 he has been engaged exclusively in gravity work with contract geophysical companies. In 1950, he organized a gravity division for Seismograph Service Corporation and served as manager of the division until April, 1953, when he was elected a vice president of Seismograph Service Corporation. On November 1, 1953, he formed Pohly Exploration Company, Tulsa.

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STEVEN H. HARRIS is senior member of the consulting geological firm of Harris & Brown of Bismarck, N. D. A graduate of the University of Cincinnati, he holds B.S. in chemistry and M.S. in geology from that institution. Prior to becoming an independent geologist, he was district stratigrapher for the Williston Basin district of Shell Oil Company. He is a member of the American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists, Sigma Xi, and Sigma Gamma Epsilon.

Conclusion

From the foregoing discussion, it is apparent that the greatest obstacles to successful exploration in the Williston Basin are not the physical problems of securing data, but are the lack of information regarding the physical qualities of the subsurface beds and the lack of real knowledge regarding the conditions which would control hydrocarbon accumulation.

The answers to these problems can come only through extensive drilling and a careful analysis of each well through accurate electric logging, sampling, and coring. In the meantime, the various exploration tools should continue to be utilized for the accumulation of data which will become interpretable as more areas are drilled.

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—The End

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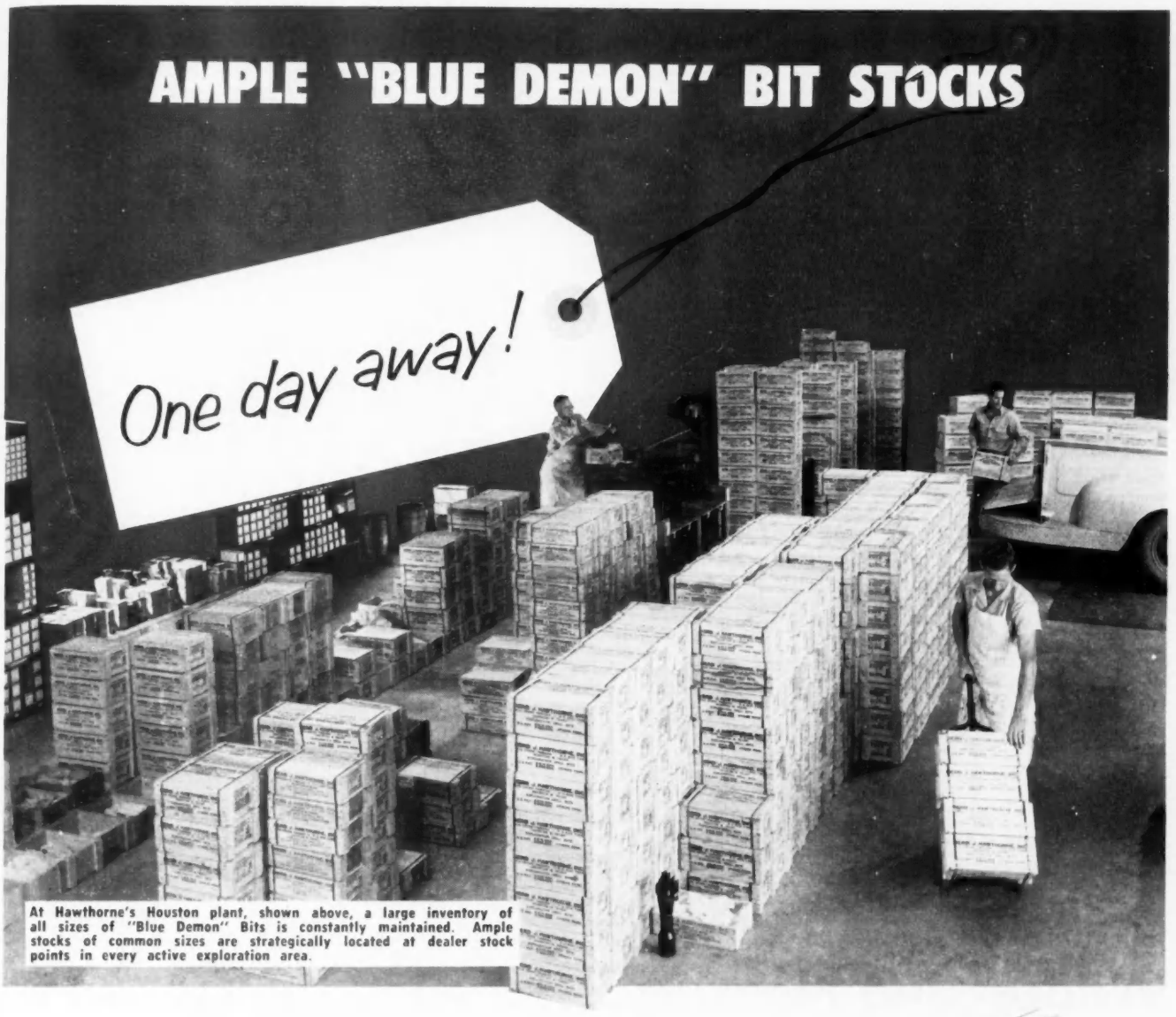

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Exploratory Drilling—in May and First Five Months 1954-1953 . . .

State or District	MONTH OF MAY, 1954													FIRST FIVE MONTHS, 1954																
	Productive Tests									Total Productive	Unproductive Tests			Total Exploratory Tests	Productive Tests								Total Productive		Unproductive Tests			Total Dry		Total Exploratory Tests	
	New Fields			New Pays			Extensions								New Fields			New Pays			Extensions									
	Oil	Dis.	Gas	Oil	Dis.	Gas	Oil	Dis.	Gas		Wildcats	New Pays	Outposts		Oil	Dis.	Gas	Oil	Dis.	Gas	Oil	Dis.	Gas	5 Mo. 1954	5 Mo. 1953	Wildcats	New Pays	Outposts	5 Mo. 1954	5 Mo. 1953	5 Mo. 1954	5 Mo. 1953
Alabama											9			9												30			30	26	30	26
Arizona																										2			2	4	2	4
Arkansas			1	1			1			3	5		1	9	1		1	2		1	1			6	12	35		3	38	40	44	52
California				1			1			2	22			24	7		2	4		1	3		1	18	35	132		2	134	183	152	218
Colorado	6	1								7	45		1	53	21	2	4				1		1	29	17	171		4	175	111	204	128
Florida											2			2	1									1		11			11	13	12	13
Georgia																										3			3	3	3	3
Idaho																														1		1
Illinois	2			3			6			11	48			59	11			13			30			54	23	223			223	158	277	181
Indiana											20			20	5		1							6	15	97			97	125	103	140
Kansas	9		3	1		1	1			15	76			91	44		9	4		1	2		1	61	80	315			315	380	376	460
Kentucky	3									3	4			7	16									16	13	22			22	43	38	56
Louisiana	4	1	3	8	1	2				19	27		3	49	13	10	7	20	12	6		1		69	49	139		3	142	147	211	196
North Louisiana		1				1				2	9		1	12	1	1	1	3		3				9	9	48		1	49	69	58	78
South Louisiana	4		3	8	1	1				17	18		2	37	12	9	6	17	12	3		1		60	40	91		2	93	78	153	118
Michigan	3						1			4	18			22	5						1			6	9	98			98	92	104	101
Mississippi											14			14								1		1	13	61		2	63	78	64	91
Missouri											1			1												6			6	7	6	7
Montana											4			4	2			1						3	3	33			33	30	36	33
Nebraska	1		1							2	7			9	8		1	1			1			11	8	43			43	62	54	70
Nevada																										2			2	5	2	5
New Mexico	3		5	1	1		2			12	14			26	9		14	2	2		4			31	21	75		1	76	51	107	72
New York																																
North Dakota											8			8	1			1			2			4	5	39			39	18	43	23
Ohio							2		2	4	4			8							3		3	6	2	7			7	10	13	12
Oklahoma	10	2	2	1	1		6			22	51			73	46	6	10	14	1	1	37	2	2	119	105	278			278	366	397	411
Pennsylvania																									1						1
South Dakota															1									1		5			5	3	6	3
Texas	41	5	4	20	8	2	16	1	2	99	349		3	451	222	25	44	91	28	10	46	7	10	483	482	1655		24	1679	1746	2162	2228
Dist. 1 S. Central	6		1				1			8	25			33	14	2	3		1		5	2	1	29	12	100		1	101	136	130	148
Dist. 2 Middle Gulf			3	1		1	1		1	7	26			33	3	4	7	2		1	3	1	2	23	25	108		3	111	123	134	148
Dist. 3 Upper Gulf	1	1		5	5	1				13	30		3	46	10	4	2	31	9	3				59	70	155		12	167	171	226	241
Dist. 4 Gulf-S.W.	4	3		4	1		1	1		14	34			48	13	9	2	18	14	2	2	4	1	65	91	162		4	166	188	231	279
Dist. 5 E. Central											12			12				1			1			2	7	51			51	61	53	68
Dist. 6 Northeast											17			17	2				1					3	9	61		1	62	59	65	68
Dist. 7-B N. Cent.	5			3					1	9	75			84	61		15	8			3		2	89	103	357			357	388	446	491
Dist. 7-C W. Cent.	6	1		1	1		1			10	21			31	20	2	5	5	1	1	3		1	38	43	131		1	132	149	170	192
Dist. 8 West	12			2			11			25	44			69	48	2	3	10	1	2	23		1	90	53	184		1	185	142	275	195
Dist. 9 North	7			4			1			12	59			71	50	1	2	16			6		1	76	67	325		1	326	328	402	395
Dist. 10 Panhandle					1					1	6			7	1	1	5		1				1	9	2	21			21	1	30	3
Utah											1			1	2		1							3	4	10			10	21	13	25
Wyoming	9						1			10	14			24	37		2	7			3			49	7	80			80	34	129	41
Total U.S.	91	9	19	36	11	5	37	1	4	213	743		8	964	452	43	96	160	43	20	134	11	18	977	904	3572		39	3611	3697	4588	4601

Wildcatting Near Record

May total off slightly but five-months' total only 13 less than in 1954.

By CECIL W. SMITH, WORLD OIL Staff

THE RATE of completing exploratory wells was slightly lower during May than it had been in the corresponding period of 1953, but the year's record through five months shows only 13 fewer exploratory tests completed than in last year's comparable period.

A total of 964 tests were completed during May, and that failed by 36 tests of matching the 1000 recorded in May of last year. The month's efforts were rewarded with an above-average number of successful tests. Out of the total drilled, 22.1 percent were completed as commercial producers and that amounted to 213 tests. A month earlier, 20 percent had proved successful, and the average for the year through five months has amounted to 21.3 percent.

In the first five months, a total of 4588 tests was completed and that amounted to 0.3 percent less than the 4601 recorded as complete in the same period of record-breaking 1953. The year's 21.3 percent success ratio was considerably better than the 19.7 percent scored last year.

This year, a total of 612 new oil pools has been opened. They include 452 new oil fields and 160 new oil pools in established fields. Those discoveries amounted to an increase of 7.6 percent over the 569 new oil pools uncovered last year.

Gas discoveries have been almost even in the two periods. A total of 116 new gas pools was located this year against last year's 113. New distillate finds have been considerably more numerous than they were in last year's period. So far distillate discoveries have totaled 86 against 64.

Summary of Results of Exploratory Drilling

ITEM	May 1954	April 1954	FIVE MONTHS January-May 1954	1953	Percent Diff.
Oil Discoveries	127	114	612	569	+ 7.6
New Fields	91	91	452	406	+11.3
New Pays	36	23	160	163	— 1.9
Distillate Discoveries	20	15	86	64	+34.4
New Fields	9	9	43	42	+ 2.4
New Pays	11	6	43	22	+95.5
Gas Discoveries	24	30	116	113	+ 5.5
New Fields	19	23	96	91	+ 5.5
New Pays	5	7	20	22	— 9.1
Total Discoveries	171	159	814	746	+ 9.1
Extensions to Fields	42	31	163	158	+ 3.2
Oil Fields	37	26	134	130	+ 3.1
Distillate Fields	1	3	11	11	0.0
Gas Fields	4	2	18	17	+ 5.9
Total Prod. Tests	213	190	977	904	+ 8.1
Dry Holes	751	759	3611	3697	— 2.3
Wildcats	743	746	3572	3626	— 1.5
New Pays					
Outposts	8	13	39	71	—45.1
Total Expl'tory Tests	964	949	4588	4601	— 0.3
Percent Productive	22.1	20.0	21.3	19.7	
Percent Dry	77.9	80.0	78.7	80.3	

U. S. Discoveries in May

NEW FIELDS, NEW PAYS AND EXTENSIONS

ARKANSAS—NEW OIL PAY

Union County, Hibank, South field. Lawton Oil Corp.'s W. J. Newsom 1-A, SE SW 35-18s-14w, Old Well Worked Over, flowed 132 barrels from Hogg sand, 3196-3200 feet, 12/64-inch, 44-gravity, completed 5-12-54, TD 3724.

ARKANSAS—OIL FIELD EXTENSION

Calhoun County, Artesian field. Western Production Co.'s J. R. Stringfellow 1, SE NE 7-15s-13w, ⅞-mile northwest extension, pumped 15 barrels from Meakin sand 2560-2578 feet, completed 5-1-54, TD 2578.

ARKANSAS—NEW GAS FIELD

Johnson County. Western Natural Gas Co.'s Charles H. Bryant 1, Section 19-9n-23w, flowed 0.2 million from 4850-5000 feet, completed 4-21-54, TD 5970.

CALIFORNIA—NEW OIL PAY

Ventura County, Oxnard field. Standard Oil Co.'s Lucas 1, 12-1n-22w, pumped 26 barrels from 8485-9025 feet, 33.3-gravity, completed 5-11-54, TD 10,570.

CALIFORNIA—OIL FIELD EXTENSION

San Luis Obispo County, Guadalupe field. Union Oil Company's Union Sugar 52-17, in 17-10n-35w, South extension, pumped 90 barrels oil and 270 barrels water from 13.9-gravity, completed 5-17-54, TD 4770.

COLORADO—NEW OIL FIELDS

Logan County. Claycomb, Auida & New Drilling Co.'s Kelley 1, SW NE 25-9n-53w, flowed 220 barrels from "J" sand, Upper Cretaceous 4832-40 feet, completed 5-18-54, TD 4920.

Unnamed field. Ginther, Warren & Ginther's Mathewson 1, SW NE SW 12-9n-55w, Old Well Drilled Deeper, pumped 51 barrels oil and 37 barrels water from "J" sand, Upper Cretaceous 5430-36 feet, completed 5-25-54, TD 5485.

Unnamed field. H. C. Arnold's State 1, NW NW SW 35-8n-54w, pumped 65 barrels oil and 43 barrels water from "J" sand, Upper Cretaceous 5099-5110 feet, completed 5-28-54, TD 5135.

Unnamed field. McDermott & Barnhardt's Armstrong 1, SW NE 34-9n-53w, pumped 199 barrels oil and 4 barrels water from "J" sand, Upper Cretaceous 4894-97 feet, completed 5-20-54, TD 5000.

Unnamed field. Miracle & Fifer's Sven Olsen 1-A, SW SE SE 3-12n-52w, flowed 40 barrels oil, 40 barrels water, and 1.3 million from "D" sand, Upper Cretaceous 5128-31 feet, completed 5-1-54, TD 5186.

Washington County. C. A. Floto's Neiman 1, SW SE SE 11-1s-55w, pumped 95 barrels from "D" sand, Upper Cretaceous 4784-88 feet, completed 5-21-54, TD 5040.

COLORADO—NEW DISTILLATE FIELD

Morgan County. S. D. Johnson's Bacon-Lind 1, C SW SW 19-3n-57w, flowed 40 barrels distillate and 2.0 million from "D" sand, Upper Cretaceous 5542-44 feet, completed 6-2-54, TD 5615.

ILLINOIS—NEW OIL FIELDS

Clay County, Passport, West field. Don Slapes West et al 1, SW NW SE 22-4n-8e, pumped 47 barrels oil and 6 barrels water from Rosiclare lime, Mississippian 3011-17 feet, completed 5-25-54, TD 3042.

Saline County, Eldorado, Central field. J. Stelle's J. J. Jones 1, NE NE SW 20-8s-7e, flowed 342 barrels from Walterburg sand, Mississippian 2106-17 feet, Paint Creek sand, Mississippian 2670-83 feet and Aux Vases sand, Mississippian 2864-72 feet, completed 5-18-54, TD 2985.

ILLINOIS—NEW OIL PAYS

Coles County, Cooks Mills field. C. Bassett's W. H. Haybrook 2, NE SW SW 2-13n-7e, pumped 11 barrels oil and 3 barrels water from Aux Vases sand, Mississippian 1764-81 feet, completed 5-25-54, TD 1825.

Lawrence County, St. Francisville, East field. F. L. Beard's G. L. Hopkins 1, NE NW NE 16-2n-11w, pumped 22 barrels oil and 100 barrels water from Pennsylvanian sand, Pennsylvanian 1305-07 feet, completed 5-25-54, TD 1912.

Saline County, Raleigh field. Breuer & Robinson's Woolard Heirs 1, NW SW SE 35-7s-6e, pumped 49 barrels oil and 100 barrels water from Tar Springs sand, Mississippian 2234-55 feet, completed 5-4-54, TD 2591.

ILLINOIS—OIL FIELD EXTENSIONS

Christian County, Blackland field. C. E. Earnest's G. H. Turner 1, SE NE NE 1-15n-1w, ½-mile northwest extension, pumped 33 barrels oil and 65 barrels water from Silurian lime, Silurian 1909-26 feet, completed 5-18-54, TD 1973.

Mt. Auburn, Central field. Hughes Production Co.'s G. R. Hardy 1, in 19-15n-1w, ¾-miles southeast extension, pumped 143 barrels from Silurian lime, Silurian 1889-94 feet and 1901-06 feet, completed 4-16-54, TD 1912.

Clay County, Sailor Springs field. Coy Oil Co.'s V. Habbs 1, NW NW SE 1-5n-6e, ¾-mile extension, pumped 30 barrels oil and 35 barrels water from Aux Vases sand, Mississippian 2709-18 feet, completed 5-25-54, TD 2718.

Washington County, Irvington field. M. Mazzarino's Reichman 1, NW NW NE 9-1s-1w, ¾-mile southwest extension, pumped 12 barrels from Cypress sand, Mississippian 1361-67 feet, completed 5-25-54, TD 1370.

Wayne County, Barnhill field. McKelvy & Sipoha's B. Vaughn 1, S½ SW NW 36-2s-8e, ½-mile west extension, pumped 70 barrels oil and 20 barrels water from Aux Vases sand, Mississippian 3291- 3306 feet, completed 5-11-54, TD 3452.

Clay City field. W. Misener's Van Fossan 1, SW SW SE 12-1s-8e ½-mile extension, pumped 14 barrels oil and 20 barrels water from Aux Vases sand, Mississippian 3057-67 feet, completed 5-4-54, TD 3188.

KANSAS—NEW OIL FIELDS

Barton County. Hilton Drilling Co.'s Lanterman 1, NW NW SE 5-20s-12w, pumped 16 barrels from Arbuckle lime, Ordovician 3394-99 feet, TD 3440.

Cowley County. Martin & Cash's Putnam 1, SE SW SE 35-43-3e, pumped 10 barrels from Hoover sand, Pennsylvanian 1980-87 feet, TD 1987.

Graham County. Hull & Wickizer et al's Wickizer 1, NW NW NE 28-10s-23w, pumped 315 barrels from Lansing lime, Pennsylvanian 3842-48 feet TD 4165.

Haskell County, Pleasant Prairie field. Helmerich & Payne's Jones 1, NW NE SW 4-27s-34w, pumped 167 barrels from Mississippi sand, Mississippian 5081-5101 feet, TD 5101.

Kingman County, Rosedale field. M. B. Armer & Midstate's Davis 1, NE SE SE 32-29s-6w, pumped 144 barrels from Kansas City lime, Pennsylvanian 3691-96 feet, TD 4660.

Morton County. Stanolind O & G Co's USA "C" 1-C, C SE 29-34s-43w, pumped 252 barrels from Morrow sand, Mississippian 4192-4205 feet, TD 4572.

Russell County. Lohmann & Johnson's Steinert 1, NW SE SW 21-15-15, pumped 10 barrels oil from Lansing lime, Pennsylvanian 3111-44 feet, TD 3376.

Stafford County, Brenn field. Heathman-Seeligson's Brenn 1, NE NE SW 19-23s-13w, pumped 153 barrels from Lansing lime, Pennsylvanian 3651-57 feet, TD 4015.

Unnamed field. Greenland Drilling Co. & NCRA's Isern 1, NE NE NE 14-24-15, pumped 324 barrels from Viola lime, Ordovician 4126-46 feet, TD 4270.

KANSAS—NEW OIL PAY

Barton County, Clarence field. Schermerhorn Oil Co.'s Merten 1-A, SW NW SW 36-19s-15w, pumped 198 barrels from Reagan sand, Permian 3543-50 feet, TD 3562.

KANSAS—OIL FIELD EXTENSION

Dickinson County, Nicholson field. Transit Corp.'s Huck 1, NE SE NW 21-11-20, ¾-mile South Extension, flowed 213 barrels from Arbuckle lime, Ordovician 3825-28 feet, TD 3828.

KANSAS—NEW GAS FIELDS

Edwards County. Sherrod & Apperson's Milhon 1, NW SE NE 28-25s-17w, flowed 3.3 million from Conglomerate 4446-60 feet, TD 4620.

Wokaty field. Cities Service Oil Co.'s Wokaty 1, NE SE NE 25-25s-17w, flowed 2.9 million from Kansas City lime, Pennsylvanian 4383-4405 feet, TD 4819.

Pawnee County. Natural Gas & Oil and Republic Natural's Starke 1, NE NE NW 24-23s-15w, flowed 2.6 million from Lansing lime, Pennsylvanian 3808-19 feet, TD 4167.

KANSAS—NEW GAS PAY

Edwards County, McCarty field. Sherrod & Apperson's Huff 1, SE NW NW 31-25s-17w, flowed 3.3 million from Conglomerate 4528-38 feet, TD 4960.

KENTUCKY—NEW OIL FIELDS

Christian County. Truman W. Drake's W. H. Putty 1, 20-H-26, pumped 20 barrels from Tar Springs sand, Mississippian 456-475 feet, completed 5-54, TD

Union County. John Buchman & Pacific Operator & C. E. O'Neal's Mary Catherine Roberts 1, in 12-0-19 pumped 120 barrels from Waltersburg sand, Mississippian 1877-1908 feet, completed 5-54, TD 2797.

Unnamed field. Walter Duncan &

Marion Dome's Edwin Alvey 1, 21-P-18, pumped 56 barrels from Aux Vases lime, Mississippian 2825-33 feet, completed 5-54, TD 3030.

NORTH LOUISIANA—NEW DISTILLATE FIELD

Lincoln Parish. Feazel Interests & Southwest Gas Producing Co. & Hunt Oil Co.'s Mrs. W. E. Dowling 1, in 19-19n-4w, flowed 221 barrels distillate and 3.5 million from Cotton Valley "D" sand, Jurassic 9203-09 and 9212-28 feet, 18/64-inch, completed 5-17-54, TD 9710.

NORTH LOUISIANA—NEW GAS PAY

Webster Parish, Ada field. Carter Oil Co.'s Nora Davis 3, C NW NE NE 34-18-8w, flowed 4.1 million from Travis Peak sand, Lower Cretaceous 8274-92 feet, ¼-inch, and 4.3 million from Cotton Valley "C" sand, Jurassic 9930-67 feet, 14/64-inch, completed 5-9-54, TD 13,775.

SOUTH LOUISIANA—NEW OIL FIELDS

Cameron Parish, West Cameron area. Magnolia Petroleum Co.'s State Lease 1153-A-1, Block 110, Gulf of Mexico, flowed 335 barrels from Miocene sand, 8140-52 feet, 12/64-inch, 34.9 gravity, completed 5-17-54, TD 10,628.

Jefferson Davis Parish. H. L. Hunt's McKinley Augustine 1, in 2-8s-6w, flowed 2000 barrels from 8921-31 feet, 8/64-inch, completed 5-17-54, TD 10,100.

Plaquemines Parish, Dixon Bay area. The California's Louisiana State 1923-1, in 23s-31e, flowed 268 barrels from 8671-80 feet, 9/64-inch, 32.6-gravity, completed 4-26-54, TD 9771.

St. James Parish. Union Oil Co. of Calif.'s Karstien 1, in 41-13s-16e, flowed 200 barrels from 10,922-944 feet, 9/64-inch 30-gravity, completed 5-5-54, TD 11,300.

SOUTH LOUISIANA—NEW OIL PAYS

Cameron Parish, Big Lake field. Kerr-McGee Oil Inc.'s J. W. Gardiner Unit 1, in 12-12s-9w, flowed 307 barrels from 10,462-465 feet, 10/64-inch, 34.2-gravity, completed 5-17-54, TD 10, 519.

Big Lake field. Stanolind O & G Co.'s Lilly LeBleu 1, in 11-12s-9w, flowed 120 barrels from 13,414-420 feet, 16/64-inch, 42-gravity, and 264 barrels from 10,412-420 feet, 9/64-inch, 34.1-gravity.

Iberville Parish, Sullivan's Lake field. Union Production Co.'s Templet et al 1, in 72-10s-11e, flowed 453 barrels oil and 45 barrels water from 12,343-347 feet, 7/64-inch, 33.6-gravity, completed 5-15-54, TD 12,558.

Jefferson Parish, Grand-Isle Block 18 field. Humble O & R Co.'s State Lease 802 C-7, Gulf of Mexico, flowed 701 barrels distillate and 0.6 million from 8082-8105 feet, ¼-inch, 32.7-gravity, completed 5-25-54, TD 8960.

Plaquemines County, West Bay field. Gulf Refining Co.'s J. G. Timolat et al, 34-B, in 25-22s-30e, flowed 227 barrels from 9862-76 feet, 9/64-inch, 28.9-gravity, completed 4-27-54, TD 11,654.

St. Mary Parish, Eugene Island-Block 126 field. Magnolia Petroleum Co.'s State Lease 691 F-4, Block 119, Gulf of Mexico, flowed 349 barrels from Miocene 7271-86 feet, 13/64-inch, 38.2-gravity, completed 5-17-54, TD 8,630.

Franklin field. Southern National Gas Co.'s Tony Perry 1, in 38-15s-9e, flowed 169 barrels from 10,309-212 feet, 12/64-inch, 32.3-gravity, completed 5-7-54, TD 12,031.

SOUTH LOUISIANA—NEW DISTILLATE PAY

Terrebonne Parish, Crescent Farms field. Arkansas Fuel & John W. Mecon's Southdown Sugars Unit 2-1, 75-17s-16e, flowed 150 barrels distillate and 6.7 million from 11,285-312 feet, ¼-inch, 50-gravity, completed 5-4-54, TD 11,500.

SOUTH LOUISIANA—NEW GAS FIELDS

Plaquemines Parish, West Delta area. Continental Oil Co.'s State Lease 977-1, Block 52, Gulf of Mexico, ungauged from Miocene 7632-42 feet, completed 5-14-54, TD 11,000.

Vermillion Parish. Texas Crude Oil and Rebstock & Reeves' Louis Albritton 1, in 11-16s-1e, ungauged from 12,398-405 feet, completed 5-12-54, TD 12,500.

SOUTH LOUISIANA—NEW GAS PAY

St. Landry Parish, Washington field. Sohio Petroleum & Gulf Refining Co.'s Thistlewaite Lbr. Co. 12, in 68-5s-4e, ungauged from 9500-10 feet, completed 5-6-54, TD 9575.

MICHIGAN—NEW OIL FIELDS

Allegan County. James J. McGerry, Trustee's Schafer 1, SW SW NE 23-3n-13w, pumped 7 barrels oil and 25 barrels water from Traverse lime, Devonian 1749-52 feet, TD 1752.

Arenac County. C. W. Collin's Moore 1, SW SW NE 23-3n-13w, pumped 5 barrels from Traverse lime, Devonian 2009-2128 feet, TD 2143.

Ottawa County, Zeeland "28" field. Miller Brothers' Masselink 1, SW NE NW 28-5n-14w, flowed 100 barrels from Traverse lime, Devonian, TD 1491.

MICHIGAN—OIL FIELD EXTENSION

Van Buren County, Lawton field. Blunt Petroleum Co.'s Shanahan 1, NE SE NE 24-4s-14w, pumped 13 barrels from Traverse lime, Devonian 1157-59 feet, TD 1159.

NEBRASKA—NEW OIL FIELD

Cheyenne County. Wytex Oil Corp.'s J. G. Bucan 1, NE NE SW 25-13n-50w, flowed 480 barrels from "J" sand, Upper Cretaceous 4933-43 feet, completed 6-3-54, TD 4949.

NEBRASKA—NEW GAS FIELD

Cheyenne County. Ohio Oil Co.'s Lobb 1, NW NW SW 2-12-51w, flowed 3.1 million from "D" sand, Upper Cretaceous 4924-32 feet, completed 5-17-54, TD 5160.

NEW MEXICO—NEW OIL FIELDS

Eddy County. Richardson & Bass' Reagan H. Legg 1, in 27-22s-30e, pumped 67 barrels oil and 204 barrels water from Delaware sand, Permian 6112-18 feet, 42.8-gravity, completed 5-11-54, TD 15,854.

Unnamed field. Stanolind O & G Co.'s State Gas Unit 1-C, in 32-17s-28e, pumped 30 barrels oil and 90 barrels water from Wolfcamp sand, Permian 7392-97 feet, 41-gravity, completed 5-25-54, TD 10,300.

Lea County. Jake L. Hamon's Federal-Davis 1, in 13-17s-38e, flowed 720 barrels from Devonian lime, Devonian 12,067-171 feet, 1-inch, 43.8-gravity, completed 5-19-54, TD 12,171.

NEW MEXICO—NEW OIL PAY

Lea County, Maljamar field. Buffalo Oil Co.'s Baish 25, in 21-17s-32e, flowed 814 barrels from Strawn sand, Pennsylvanian 11,616-660 feet, 9/64-inch, 441.2-gravity, completed 5-1-54, TD 12,778.

NEW MEXICO—OIL FIELD EXTENSION

Lea County, North Echols field. The Texas Co.'s State Lease 1, in 28-10s-37e, ¾-mile southeast extension, flowed 297 barrels from Devonian lime, Devonian 11,798-816 feet, 12/64-inch, 42.6-gravity, completed 5-24-54, TD 12,000.

Teas field. W. H. Black's Federal 1-C, in 14-20s-33e, southwest extension, pumped 118 barrels from Yates sand, Permian 3317-39 feet, 2-inch, 34-gravity, completed 4-16-54, TD 3339.

NEW MEXICO—NEW DISTILLATE PAY

Eddy County, Artesia field. Stanolind's State of New Mexico 1-AD, in 10-19s-28e, flowed 5 barrels distillate and 3.9 million from Pennsylvanian sand, Pennsylvanian 11,018-028 and 11,050-060 feet, 2-inch, 48-gravity, completed 5-1-54, TD 13,260.

NEW MEXICO—NEW GAS FIELDS

Rio Arriba County. Phillips' Mesa Unit 3-9, 30-5, NE SW SW 9-30n-5w, flowed 1.4 million from Mesaverde sand, Upper Cretaceous, completed 5-21-54, TD 5862.

Unnamed field. Phillips Petroleum Co.'s Indian 1-E, SE NW NE 31-29n-3w, flowed 20.1 million from Pictured Cliffs sand, Upper Cretaceous 3832-3905 feet, completed 5-14-54, TD 3905.

Unnamed field. Southern Union Gas Co.'s Jicarilla 2-A, NE SW SW 14-26n-4w, flowed 5.0 million from Pictured Cliffs sand, Upper Cretaceous 3557-3619 feet, completed 5-5-54, TD 3619.

San Juan County. F. B. Marshall's Marron 1, SW SW SW 24-27n-8w, flowed 1.6 million from Pictured Cliffs sand, Upper Cretaceous 2160-2244 feet, completed 3-11-54, TD 2250.

Unnamed field. McConnell Drilling Co.'s Payne 1, NE SW SW 13-26n-9w, flowed 2.8 million from Pictured Cliffs sand, Upper Cretaceous 2010-2109 feet, completed 1-29-54, TD 2109.

OHIO—OIL FIELD EXTENSIONS

Coshocton County, New Castle field. Dave Shafer & Son's L. E. Allen 1, Section 2, Jefferson, pumped 48 barrels from Clinton sand, Silurian 3324-32 feet, completed 6-1-54, TD 3360.

Medina County, Chippewa field. National Gas & Oil Corp.'s Gabriel Gaig No. 2, Lot 10, Wadsworth, flowed 60 barrels from Clinton sand, Silurian 3810-14 feet, completed 5-18-54, TD 3817.

OHIO—GAS FIELD EXTENSIONS

Coshocton County, West Carlisle field. Baird & Co.'s T. S. Powell 1, Lot 24, Washington, 2-mile east extension, flowed 0.9 million from Clinton sand, Silurian 3529-38 feet, completed 6-2-54, TD 3627.

Guernsey County, Cambridge field. Buc-Col Inc.'s Frank Newhart 1, Section 20, Richland, flowed 0.3 million from Berea sand, Mississippian 1329-30 feet, completed 5-19-54, TD 1330.

OKLAHOMA—NEW OIL FIELDS

Beckham County. Earl C. Ward et al's Van N. Vactor 1, SW NW NW 19-8n-21w, flowed 120 barrels from 1470-1522 feet, ¼-inch, 39.5 gravity, TD 1554.

Carter County. Sinclair O & G Co.'s Leon G. Voorhees 1, NE NW NE 13-3s-3w, flowed 49 barrels from Sycamore lime, Mississippian 6203-32 feet, ¼-inch, 42-gravity, TD 6511.

Unnamed field. C. W. Van Eaton et al's Winters 1, SW SE SE 12-5s-1w, pumped 100 barrels from Deese sand, Pennsylvanian 3510-21 feet, 35-gravity, TD 5027.

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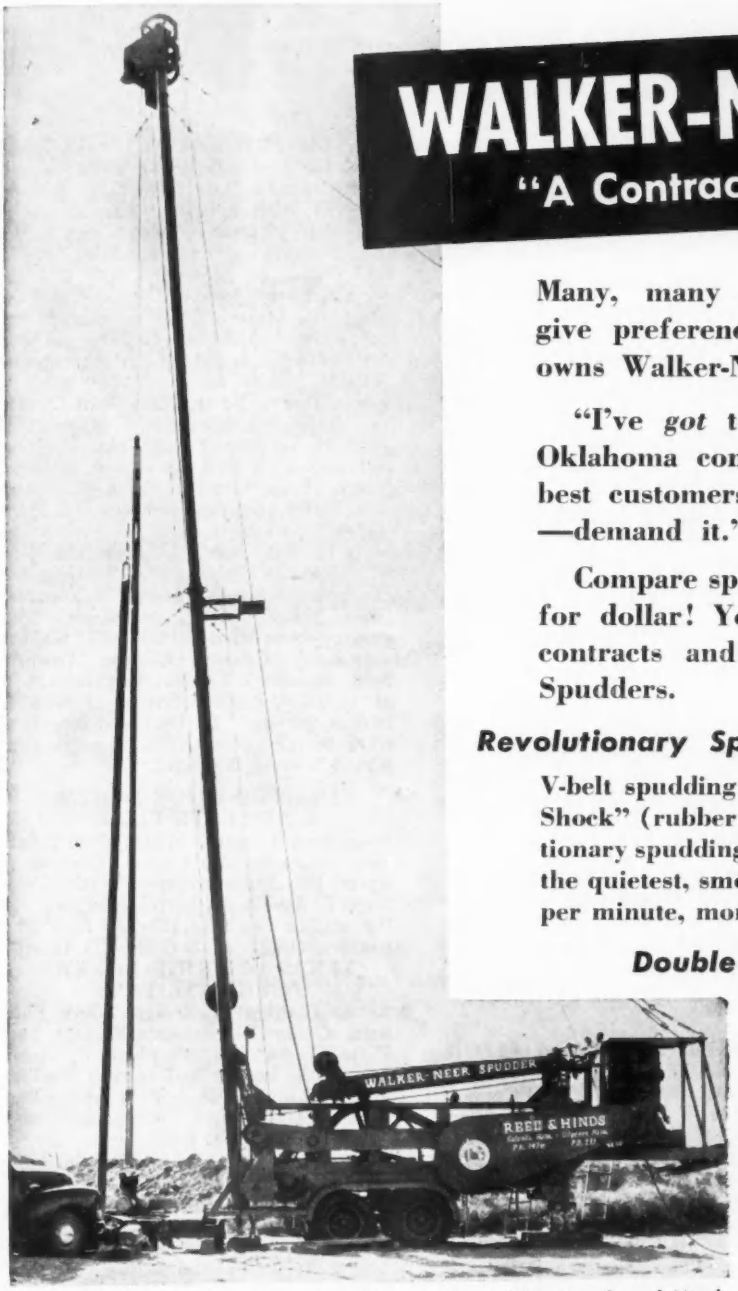

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Okfuskee County. Cyclone Drilling Co.'s Shealey 1, NE NE SW 9-12n-8e, pumped 47 barrels from Cromwell sand, Pennsylvanian 3714-20 feet, 40-gravity, TD 3720.

Osage County. Oras A. Shaw's Osage 1, SW NE SE 30-26n-6e, flowed 1800 barrels from Burbank sand, Pennsylvanian 2930-49 feet, ½-inch, 39-gravity, TD 2949.

Unnamed field. Rushmore & Tresner et al's Osage 3, NW NE NE 10-26n-9e, pumped 30 barrels from Bartletsville sand, Pennsylvanian 1946-52 feet, TD 2070.

Unnamed field. M. B. Schrier's Osage 1, SE SE NW 3-25n-7e, pumped 23 barrels oil and 3 barrels water from Prue sand, Pennsylvanian 2468-76 feet, 38-gravity, TD 2755.

Payne County. T. W. & J. M. Loffland, Jr.'s State 1, SE SW NW 16-20n-2e, pumped 18 barrels oil and 2 barrels water from Burgess sand, Mississippian 4518-27 feet, TD 4919.

Tillman County. S. D. Johnson's Maguire 1, SW SW NE 3-3s-19w, flowed 140 barrels from Strawn lime, Pennsylvanian 4952-62 feet, ⅛-inch, 49.8-gravity, TD 5904.

OKLAHOMA—NEW OIL PAY

Noble County, Fourdee field. W. C. McBride, Inc.'s E. Henke et al 1, NE NW NE 1-21n-2w, pumped 175 barrels from Vertz sand, Permian 1892-1903 feet, TD 2007.

OKLAHOMA—OIL FIELD EXTENSIONS

Creek County, Depew, Northwest field. Gulf's Estate 1, SE SW NW 26-16n-7e, pumped 45 barrels from Prue sand, Pennsylvanian 2620-44 feet, 38-gravity.

McClain County, Freeney, North field. Kenneth A. Ellison's Cleveland 1, C NE NW 2-8n-4w, flowed 155 barrels from Hunton lime, Silurian 9180-9240 feet, 14/64-inch, 40-gravity, TD 10,285.

Okfuskee County, Castle, Southwest field. Berg & Buck, Drilling Co's Camp 1, SE NW NW 7-11n-9e, flowed 77 barrels from Gilcrease sand, Pennsylvanian 3318-42 feet, ¾-inch, TD 3355.

Haydenville field. William H. Pine's McMillen 1, NW SE NW 20-13n-10e, flowed 454 barrels from Cromwell sand, Pennsylvanian 3078-89 feet, 2-inch, 41-gravity, TD 3089.

Payne County, Middle Coyle field. Olin Industries, Inc.'s Arvil Cundiff 1, NE NW NW 9-17n-1e, flowed 50 barrels from 1st Wilcox sand, Ordovician 5159-63 feet, ¼-inch, and 14 barrels from 2nd Wilcox sand Ordovician 5216-19 feet, 44-gravity, TD 5260.

OKLAHOMA—NEW DISTILLATE FIELDS

Beckham County. Herman Brown's Mancy A. Ham 1, C NE NW 25-10n-26w, flowed 22 barrels distillate and 2.0 million from Pawhuska sand, Pennsylvanian 5635-44 feet, ¼-inch, TD 10,294.

Major County. Julius Livingston's H. D. Sherman 1, NE SW SE 5-21n-9w, flowed 1.5 barrels distillate and 1.1 million from Cherokee sand, Pennsylvanian 6627-58 feet, 12/64-inch, 62-gravity, TD 6970.

OKLAHOMA—NEW DISTILLATE PAY

Stephens County, Velma field. Altus Drilling Co's W. J. Saird, NE NW NE 22-1s-5w, flowed 30 barrels distillate and 3.9 million from Sycamore lime, Mississippian 4690-4730 feet, 5/16-inch, TD 4877.

OKLAHOMA—NEW GAS FIELDS

Payne County. Gulf Oil Corp.'s Luther Mollay 1, SW NW SW 7-17n-4e, flowed 2.8 million from Upper Skinner sand, Pennsylvanian 3670-84 feet, TD 4479.

Texas County. United Production Co.'s Loren Sillars 1, C NW SE 36-2n-19ecm, flowed 23.0 million from Morrow sand, Pennsylvanian 6752-72 feet, TD 7232.

TEXAS DISTRICT 1—NEW OIL FIELDS

Atascosa County, "Barry & Moore" field. Barry & Moore's Sarah Ferry 1, Thomas Orr Survey 241, pumped 70 barrels from Carrizo sand, Eocene 2156-63 feet, 22.1-gravity, completed 5-10-54, TD 2173.

Charlotte area. Armstrong & Horn—M. E. Andrews' G. L. Tullos 1, L. B. Taliaferro Survey 1956, flowed 131 barrels from Navarro sand, Upper Cretaceous 5262-81 feet, ⅛-inch, 38.2-gravity, completed 5-2-54, TD 5297.

Bexar County, Saspamco area. B. M. Jacobs' Joseph Hartl 1, Marianna Seguin Survey, flowed 267 barrels from 2900-3037 feet, ¼-inch, 30-gravity, completed 5-9-54, TD 3037.

La Salle County, "Los Angeles" field. J. E. Mowinckle's Robert Harris 1, Block 1, I&GN Survey, flowed 55 barrels from 3755-68 feet, 9/64-inch, 41.7-gravity, completed 5-21-54, TD 3830.

TEXAS DISTRICT 1—OIL FIELD EXTENSION

Atascosa County, Big Foot field. Big "6" Drilling Co.'s H. T. Nisbett Est. 2-B, B. Littleton Survey, 1-mile east extension, flowed 38 barrels from 3840-58 feet, 5/32-inch, 38.6-gravity, completed 5-1-54, TD 3858.

TEXAS DISTRICT 1—NEW GAS FIELD

La Salle County, "Amerson" field. Imperial Production Corp.'s Amberson Land & Cattle Co. 2, GC&SF RR Co. Survey, flowed 2.1 million from 4422-26 feet, completed 5-21-54, TD 4523.

TEXAS DISTRICT 2—NEW OIL PAY

De Witt County, Hynes field. Francis J. Hunes's W. J. Lau 1, Miguel Ortiz Survey, flowed 185 barrels from Wilcox-Massive sand, Eocene 8181-85 feet, 10/64-inch, 42.8-gravity, completed 4-30-54, TD 8227.

TEXAS DISTRICT 2—OIL FIELD EXTENSION

Refugio County, Mary Ellen O'Connor field. Humble O & R Co.'s Mary Ellen O'Connor 11-B, BB&C RR Co. Survey, ¾-mile southeast extension, flowed 104 barrels from 5877-5882 feet, ⅛-inch, 39.2-gravity, and 121 barrels from 5441-5547 feet, ⅛-inch, 31.8-gravity, completed 5-5-54, TD 6202.

TEXAS DISTRICT 2—NEW GAS FIELDS

Jackson County. Magnolia's J. H. Robinson 1-B, Jessie Wilson Survey, flowed 42.0 million from 3912-18 feet, completed 5-19-54, TD 4815.

Victoria County. Kirby O&G Co.'s R. E. Foster 1, T&NO Survey, flowed 6.3 million from Cockfield sand, Eocene 5522-28 feet, completed 4-30-54, TD 8517.

TEXAS DISTRICT 2—NEW GAS PAY

Goliad County, Albrecht field. McKenzie Drilling Co. & Buford Goodwin's Victoria Albrecht 1, M. Carriona Survey, flowed 7.5 million from Frio sand, Oligocene 2770-90 feet, completed 5-6-54, TD 4635.

TEXAS DISTRICT 2—GAS FIELD EXTENSION

Goliad County, Fannin, West field. A. B. Alkek's G. G. Swickheimer 1, Manuel de la Pena Survey, ½-mile west extension, flowed 11.9 million from Frio sand, Oligocene 4109-19 feet, completed 5-17-54, TD 4247.

TEXAS DISTRICT 3—NEW OIL FIELD

Montgomery County. Magnolia's Chase National Bank 1, D. Garrett Survey, pumped 58 barrels oil and 2 barrels water from 9188-96 feet, 34.5-gravity, completed 5-3-54, TD 12,276.

TEXAS DISTRICT 3—NEW OIL PAYS

Harris County, Alco-Mag field. C. B. Wrightsman's Harris Co. Ld. & Imp. Co. 1-B, Victor Blanco Survey, flowed 182 barrels from 8052-55 feet, 9/64-inch, 39-gravity, completed 5-7-54, TD 8972.

Mykawa field. Jack W. Frazier's Allison-Minnetex Unit 1, William Lovett Survey, flowed 313 barrels from 4850-53 feet, 12/64-inch, 26.6-gravity, completed 5-15-54, TD 4870.

Jasper County, North Buna field. American Republics Corp. & Houston Oil's John D. Johnson Fee 3, John D. Johnson Survey, flowed 13 barrels from 1st Yegua sand, Eocene 6696-6702 feet, ¼-inch, 32.9-gravity, completed 5-13-54, TD 8112.

Liberty County, North Dayton field. John W. Mecom's Quintette 2, Section 125, H & TC Survey, flowed 365 barrels from 5880-90 feet, 3/16-inch, 35.3-gravity, completed 5-15-54, TD 6969.

Montgomery County, Conroe Townsite field. Humble's Federal Royalty Co. et al 1, John Bricker Survey, flowed 26 barrels oil and 22 barrels water from 6312-16 feet, ½-inch, 36.1-gravity, completed 5-30-54, TD 6348.

TEXAS DISTRICT 3—NEW DISTILLATE FIELD

Montgomery County, Willis, North field. The Superior Oil Co. & Carlton D. Speed Jr.'s James Sykes 1, William Weir Survey, flowed 35 barrels distillate and 0.9 million from 11,198-210 feet, 54.2-gravity, completed 5-6-54, TD 13,062.

TEXAS DISTRICT 3—NEW DISTILLATE PAYS

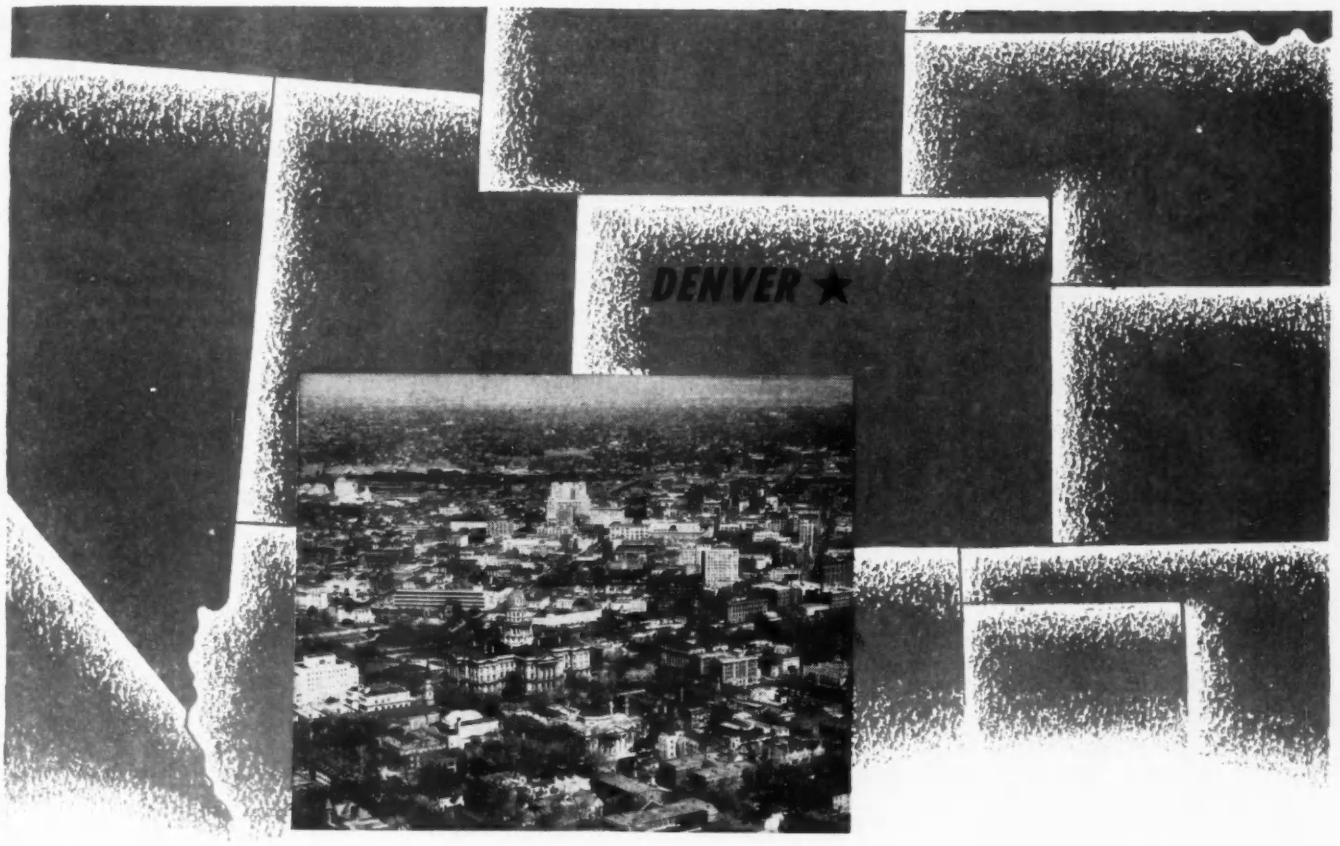
Brazoria County, Lockridge, South Flank field. George R. Brown's Ramsey State Farm Tract 1-G, Stephen F. Austin League 9, flowed 167 barrels distillate and 23.0 million from Frio sand, Oligocene 6600-05 feet, 43-gravity, completed 4-18-54, TD 8433.

Harris County, Rankin, South field. Houston Oil's Alex Keller et al 1-A, William Whitlock Survey, flowed 164 barrels distillate and 3.6 million from 2nd Cook Mountain sand, Eocene 8982-89 feet, 54-gravity, completed 5-2-54, TD 9250.

Jefferson County, Big Hill, W. Flank field. Deep South Oil Co. of Texas' Security Bank 9, T&NO RR Survey, flowed 333 barrels distillate and 28.0 million from 9072-90 feet, 50-gravity, completed 4-20-54, TD 11,770.

Marrs McLean field. Stanolind's Marrs McLean 2-B, L. Hempshire Survey, flowed 882 barrels distillate and 45.0 million from Frio "B" sand, Oligocene 11,072-086 feet, 48.7-gravity, completed 5-21-54, TD 12,208.

Orange County, Pt. Neches, North field. Gulf Oil Corp.'s C. S. Hollis, et al 1, John Stephenson Survey, flowed 2088 barrels distillate and 57.0 million from Frio sand, Oligocene 7802-08 feet, 60.4-gravity, completed 3-27-54, TD 8230.



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TEXAS DISTRICT 3—NEW GAS PAY

Wharton County, Louise field. W. V. Bowles & Co.'s Willis McIntyre et al 1, Morris & Cummings Survey, flowed 6.7 million from Frio sand, Oligocene 5484-90 feet, completed 4-2-54, TD 7250.

TEXAS DISTRICT 4—NEW OIL FIELDS

Nueces County. Edwin L. Cox's John Davis Est. 1, George H. Paul Subdivision of Driscoll Ranch Section 63, flowed 84 barrels oil and 15 barrels water from Frio sand, Oligocene 5775-79 feet, ⅛-inch, 34-gravity, completed 5-17-54, TD 5962.

"London, Southeast" field. Christie, Mitchell & Mitchell's M. P. Crook 1, Laureles Farm Tract, Section 26, flowed 102 barrels from Catahoula sand, Oligocene 4554-60 feet, 9/64-inch, 30.1-gravity, completed 5-4-54, TD 10,052.

San Patricio County. Phillips Petroleum Co.'s "Key" 3, John Smith Survey, flowed 70 barrels from Catahoula sand, Oligocene 4006-10 feet, 9/64-inch, 22-1-gravity, completed 5-29-54, TD 6616.

TEXAS DISTRICT 4—NEW OIL PAYS

Brooks County, Mills Bennett field. Mills Bennett's Fee 8, Juan Jose Guerra Survey, flowed 98 barrels from Frio sand, Oligocene 5230-36 feet, ⅛-inch, 46.2-gravity, completed 5-16-54, TD 6000.

Starr County, El Benadito field. Magnolia's W. T. Neblett 10, Subdivision "B," Share 4, Tract E, El Benadito Grant, flowed 106 barrels from 22-C sand, Oligocene 5858-61 feet, 7/64-inch, 39.7-gravity, completed 5-3-54, TD 5920.

Rincon, North field. Sun Oil Co.'s George H. Coates-State 4-A, Francisco Alvarado Survey 516, flowed 154 barrels from Vicksburg sand, Oligocene 6862-72 feet, 9/64-inch, 43.4-gravity, completed 5-9-54, TD 7000.

Webb County, Aguilares field. Skelly Oil Co.'s J. O. Walker 1, EL & RR Survey 471, flowed 206 barrels oil and 14 barrels water from Wilcox sand, Eocene 6724-29 feet, 3/16-inch, 36.3-gravity, completed 5-18-54, TD 7120.

TEXAS DISTRICT 4—OIL FIELD EXTENSION

Aransas County, Puerto Bay field. William Herbert Hunt Tr. Est.'s Bankers Mortgage Co. 1, Taft Farm Lands, Section 78, ½-mile northwest extension, flowed 120 barrels from 6752-54 feet, ⅛-inch, 44.8-gravity, completed 5-13-54, TD 7296.

TEXAS DISTRICT 4—NEW DISTILLATE FIELDS

Aransas County. Sam F. Wilson, Jr. & Jay Callahan's Ocker Brothers 1, C. B. Lucas Subdivision, Block 3, Lot 17, flowed 216 barrels distillate and 6.0 million from Upper Frio sand, Oligocene 7442-48 feet, 64-gravity, completed 4-15-54, TD 10,051.

Jim Wells County, "La Gloria, West" field. Lewis O. Kelsey & Horance Spiller's Jessie Jackson 1, Eureka College Subdivision 1, Block 6, flowed 270 barrels distillate and 9.0 million from 5686-95 feet, 64.4-gravity, completed 4-23-54, TD 7138.

TEXAS DISTRICT 4—NEW DISTILLATE PAY

Hidalgo County, San Carlos field. Magnolia's Santa Crux Farms 4, San Salvador Del Tule Grant, Santa Cruz Ranch Subdivision, Block 64, flowed 155 barrels distillate and 36.0 million from Frio sand, Oligocene 7508-22 feet, 55.2-gravity, completed 4-12-54, TD 9070.

TEXAS DISTRICT 4—DISTILLATE FIELD EXTENSION

Jim Wells County, Alice Deep field. W. B. Osborn, Operator's Otto Goldapp B-1, La Vaca Jose Maria Garcia Grant, Welausen Subdivision, Block 4, 1-mile west extension, flowed 250 barrels distillate and 7.4 million from Crockett sand, Eocene 8194-8212 feet, 55.1-gravity, completed 3-6-54, TD 12,516.

TEXAS DISTRICT 7-C—NEW OIL FIELDS

Crockett County, "Tippett, East" field. Bankline Oil Co. & Hurt Oil Co., Ltd's Rennee Mayberry-Forristall 41-1, Section 41, Block 13, H&TC Survey, flowed 1680 barrels from Upper Wolfcamp lime, Permian 6187-6217 feet, ¾-inch, 36.5-gravity and 1432 barrels from Lower Wolfcamp 6294-6330 feet, ¾-inch, 36.5-gravity, completed 5-7-54, TD 6517.

Kimble County. Barron Kidd & Cherry Bros' J. W. Johnson 1, M. A. Kadle Survey, flowed 10 barrels and 1 barrel water from Pennsylvanian sand 1072-75 feet, ½-inch, 19.8-gravity, completed 4-29-54, TD 1127.

Runnels County. Currey, Shield & Currey's J. M. Mackey 1, J. Meyers Survey, flowed 111 barrels from Cross Cut sand, Pennsylvanian 4239-44 feet, ¼-inch, 37.5-gravity, completed 5-15-54, TD 4296.

Unnamed field. S. C. Herring Drilling Co's R. L. Williams Est. 1, Wharton CSL Survey, flowed 156 barrels from Morris sand, Pennsylvanian 3720-26 feet, ¼-inch, 40-gravity, completed 5-3-54, TD 4210.

Schleicher County. L. E. Scherck's Minnie Wilson 2, Section 14, Block 1, GH&SA Survey, pumped 211 barrels from Canyon sand, Pennsylvanian 4033-49 feet, 31.5-gravity, completed 5-14-54, TD 4054.

Tom Green County. Stanolind's J. Willis Johnson 1-F, Section 4, Block 25, H&TC Survey, flowed 112 barrels from Palo Pinto Lime, Pennsylvanian 4509-19 feet, 16/64-inch, 43.7-gravity, and flowed 22 barrels from Strawn sand, Pennsylvanian 4883-4901 feet, 22/64-inch, 41-gravity, completed 4-13-54, TD 4970.

TEXAS DISTRICT 7-C—NEW OIL PAY

Upton County, Amacker-Tippett field. Hunt Oil Co.'s V. T. Amacker 1-62, Section 62, Block Y, TCRR Survey, flowed 260 barrels from Strawn sand, Pennsylvanian 9716-80 feet, 12-64-inch, 43-gravity, completed 5-25-54, TD 12,650.

TEXAS DISTRICT 7-C—OIL FIELD EXTENSION

Tom Green County, Funk field. E. H. Cox' Ike Funk 1, Section 22, Block 5, H&TC Survey, 2½-mile southeast extension, pumped 9 barrels and 1 barrel water from San Andres sand, Permian 784-874 feet, 24.3-gravity, completed 5-17-54, TD 874.

TEXAS DISTRICT 7-C—NEW DISTILLATE PAY

Tom Green County, Christoval field. Stanolind's J. W. Johnson 2-A, C. M. Dunn Survey, Old Well Worked Over, flowed 10 barrels distillate and 1.9 million from Strawn Reef sand, Pennsylvanian, 5244-59 feet, 22/64-inch, 50-gravity, completed 5-8-54, TD 5782.

TEXAS DISTRICT 8—NEW OIL FIELDS

Andrews County. The Texas Co's J. E. Mabee 1-B, Section 10, Block 40, T-2-N, T&P Survey, pumped 52 barrels from Wolfcamp lime, Permian 8793-9808 & 9873-9944 feet, 42.2-gravity, completed 5-5-54, TD 13,102.

Borden County, "Arthur" field. Texas Crude et al's Lester E. Brown 1-44, Section 44, Block 33, T-4-N, T&P Survey, flowed 271 barrels and 10 barrels water from Spraberry sand, Permian 7466-7560 feet, ½-inch, 38.2-gravity, completed 4-7-54, TD 8923.

Unnamed field. Barhaney Drilling Co. Inc's Acosta 1, Section 8, Block 33, T-3-N, T&P Survey, pumped 105 barrels and 8 barrels water from Spraberry sand, Permian 7565-7600, 7630-80 & 8050-85 feet, 35.8-gravity, completed 5-15-54, TD 9185.

Ector County. The Texas Co's TXL 1-B, Section 9, Block 45, T-1-N, T&P Survey, flowed 314 barrels from Fussleman lime, Silurinan 7954-77 feet, ½-inch, 41-gravity, completed 5-16-54, TD 8426.

Garza County. R. L. Turley, et al's Charles A. Bird 1, Section 3, Block 8, H&GN Survey, pumped 11 barrels and 7 barrels water from San Angelo sand, Permian 2614-26 feet, 37-gravity, completed 5-21-54, TD 2668.

Hockley County, Hoblitzelle field. Great Western Drilling Co. & Karl Hoblitzelle's J. L. Hines 1, Labor 23, League 736, State Capitol Lands Survey, pumped 155 barrels from Wolfcamp lime, Permian 8322-42 & 8382-8418 feet, 28-gravity, completed 5-23-54, TD 10,215.

Howard County. Van-Grisso Oil Co. & W. W. Harvey's E. J. Carpenter 1, Section 7, Block 25, H&TC Survey, flowed 497 barrels from Wolfcamp Reef lime, Permian 6675-6702 feet, 22/64-inch, 37.3-gravity, completed 5-14-54, TD 6702.

Martin County. Fran Drilling Co's G. W. Glass 1-D, Section 23, Block 38, T-1-N, T&P Survey, flowed 68 barrels and 19 barrels water from Pennsylvanian sand 10,475-552 feet, ½-inch, 48.6-gravity, completed 4-23-54, TD 10,612.

Midland County, Seaboard Oil Co's W. R. Tillman 1, Section 12, Block X, H. P. Hilliard Survey, flowed 109 barrels and 18 barrels water from Strawn sand, Pennsylvanian 10,450-510 feet, 12/64-inch, 46.5-gravity, completed 5-7-54, TD 12,700.

Mitchell County. McAlester Fuel Co's Roy Largent 1-A, Section 8, Block 17, SPRR Survey, flowed 69 barrels from Fusselman lime, Silurian 8465-70 feet, ¼-inch, 41.4-gravity, completed 5-16-54, TD 8794.

Scurry County. J. L. Mayfield's R. H. Jordan 1, Section 599, Block 97, H&TC Survey, flowed 186 barrels from Strawn sand, Pennsylvanian 7900-58 feet, 10/64-inch, 40.7-gravity, completed 5-18-54, TD 7962.

Sutton County. Blue Bonnet O&G Co's H. Walker Est. 1, Section 63, Block K, GH&SA Survey, flowed 120 barrels from Canyon Reef lime, Pennsylvanian 2946-64 feet, ¼-inch, 35.3-gravity, completed 3-29-54, TD 6913.

TEXAS DISTRICT 8—NEW OIL PAYS

Hockley County, D. L. S. field. Stanolind's Dorothy L. Slaughter 2, Zavalla CSL Survey, pumped 114 barrels from Wolfcamp lime, Permian 8606-8710 & 8744-67 feet, 30-gravity, completed 5-5-54, TD 9400.

Ward County, Payton field. W. P. Luse & C. O. Ice's J. I. Dorr et al 1-A, Section 2, Block 32, H&TC Survey, pumped 15 barrels and 11 barrels water from Wichita-Albany lime, Permian 5952-96

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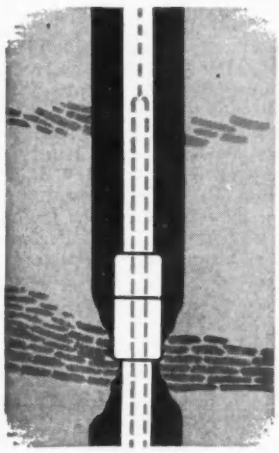

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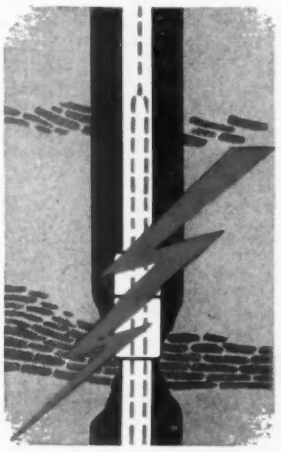

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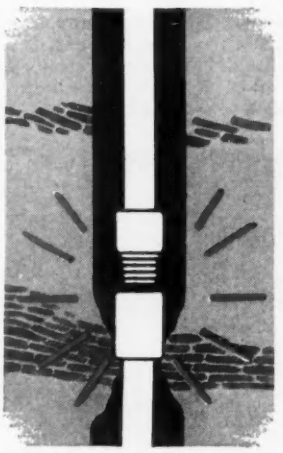

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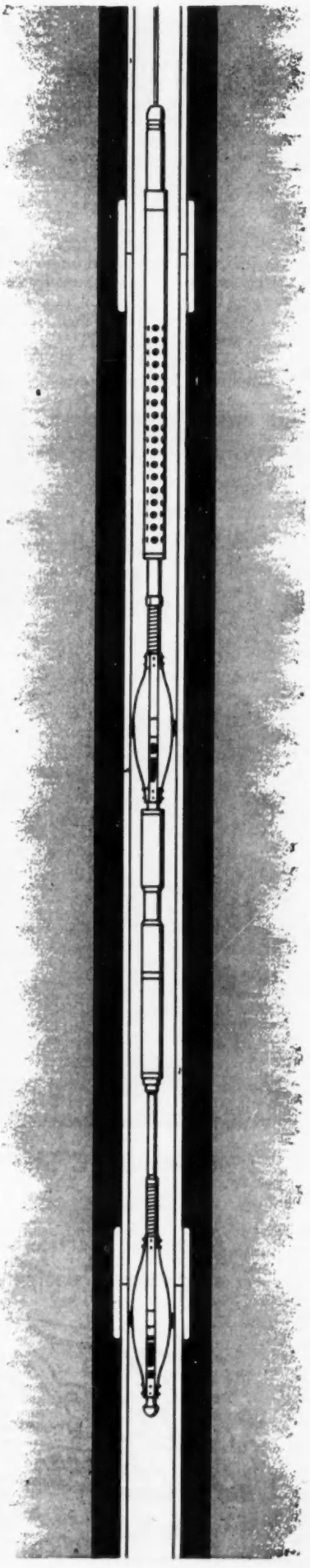

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feet, 37.5-gravity, completed 3-19-54, TD 7096.

TEXAS DISTRICT 8—OIL FIELD EXTENSIONS

Andrews County, Emma field. Anderson-Prichard's University 1-36, Section 36, Block 10, University Lands Survey, ½-mile north extension, flowed 523 barrels from Ellenburger lime, Ordovician 12,302-400 feet, ½-inch, 50.3-gravity, completed 5-25-54, TD 12,475.

Emma field. Superior's University "36-A" 1, Section 36, Block 10, University Lands Survey, ½-mile northeast extension, flowed 554 barrels from Ellenburger lime, Ordovician 12,279-300 & 12,312-346 feet, 12/64-inch, 49.2-gravity, completed 5-2-54, TD 12,637.

Dawson County, Ackerly field. Joe A. Humphrey's J. L. Billingsley 1, Section 12, Block 34, T-3-N, T&P Survey, 1¾-mile southeast extension, flowed 209 barrels from Pennsylvanian sand 9206-18 feet, ¼-inch, 39.6-gravity, completed 5-2-54, TD 9233.

Arvanna field. The Eastland Oil Co's J. E. Ray 1, Section 2, Block 35, T-5-N, T&P Survey, 1¼-inch, 35-gravity, completed 4-20-54, TD 4466.

Gaines County, Tex-Mex field. Hanley Co's Dunbar 1-A, Section 4, Block A-28, PSL Survey, ½-mile southwest extension, flowed 243 barrels from San Andres lime, Permian 4344-80 feet, 1-inch, 31.4-gravity, completed 4-28-54, TD 4394.

Howard County, Oceanic field. A. O. Wellman & Sons & Texas Crude's Jones 2-35, Section 35, Block 33, T-3-N, T&P Survey, 1½-mile southwest extension, flowed 2106 barrels from Pennsylvanian lime 8210-47 feet, ½-inch, 42.6-gravity, completed 5-9-54, TD 8247.

Snyder field. Paul De Cleva's M. H. O'Daniel 1, Section 20, Block 30, T-1-S Survey, ½-mile southeast extension, pumped 85 barrels and 13 barrels water from San Andres lime, Permian 2760-3046 feet, 31-gravity, completed 4-22-53, TD 3046.

Scurry County, Fluvanna field. Fred Goodstein's E. J. Browning 1, Section 537, Block 97, H&TC Survey, ½-mile southeast extension, flowed 203 barrels from Strawn sand, Pennsylvanian 7866-81 feet, 28/64-inch, 41.4-gravity, completed 5-13-54, TD 8373.

Ward County, Pyote field. Homo Oil Co. et al's University 2-C, Section 19, Block 16, University Lands Survey, west extension, pumped 21 barrels from Delaware lime, Permian 2824-38 feet, 35.1-gravity, completed 4-8-54, TD 2838.

Yoakum County, Brahaney field. Hunt Oil Co's H. P. Bybee 1, Section 514, Block D, Gibson Survey, ½-mile west extension, pumped 63 barrels and 30 barrels water from San Andres lime, Permian 5208-76 feet, 35.3-gravity, completed 5-12-54, TD 5276.

TEXAS DISTRICT 10—NEW DISTILLATE PAY

Roberts County, Quinduno field. Gulf's John Haggard 1, Section 5, Block 2, I&GN Survey, Old Well Drilled Deeper, flowed 230 barrels distillate and 16.3 million from Granite Wash lime, 7248-60 feet, 70-gravity, completed 4-2-54, TD 12,597.

WYOMING—NEW OIL FIELDS

Converse County. True & Brown's State 22-2, SW SW 22-33n-76w, flowed 275 barrels from Lower Muddy sand, Upper Cretaceous 5132-50 feet, completed 4-5-54, TD 5296.

Niobara County. Continental Oil Co's Government 1, SE NE SW 2-35n-64w, pumped 300 barrels from Dakota sand, Upper Cretaceous 4012-22 feet, completed 5-4-54, TD 4058.

Unnamed field. Great Basins' Gov't. 41-20, C NE NE 20-39n-65w, flowed 120 barrels from Newcastle lime, Upper Cretaceous 7539-50 feet, completed 5-18-54, TD 7554.

Unnamed field. Great Basins Petroleum Co's Government 43-11, SE NE SE 11-38n-65w, pumped 32 barrels from Newcastle lime, Upper Cretaceous 7089-7123 feet, completed 4-10-54, TD 7201.

Unnamed field. R. L. Manning-Cosden Petroleum Co's Gov't.-Bell 1, C SE NE 4-40n-66w, flowed 151 barrels from Newcastle lime, Upper Cretaceous 7728-43 feet, completed 5-27-54, TD 7825.

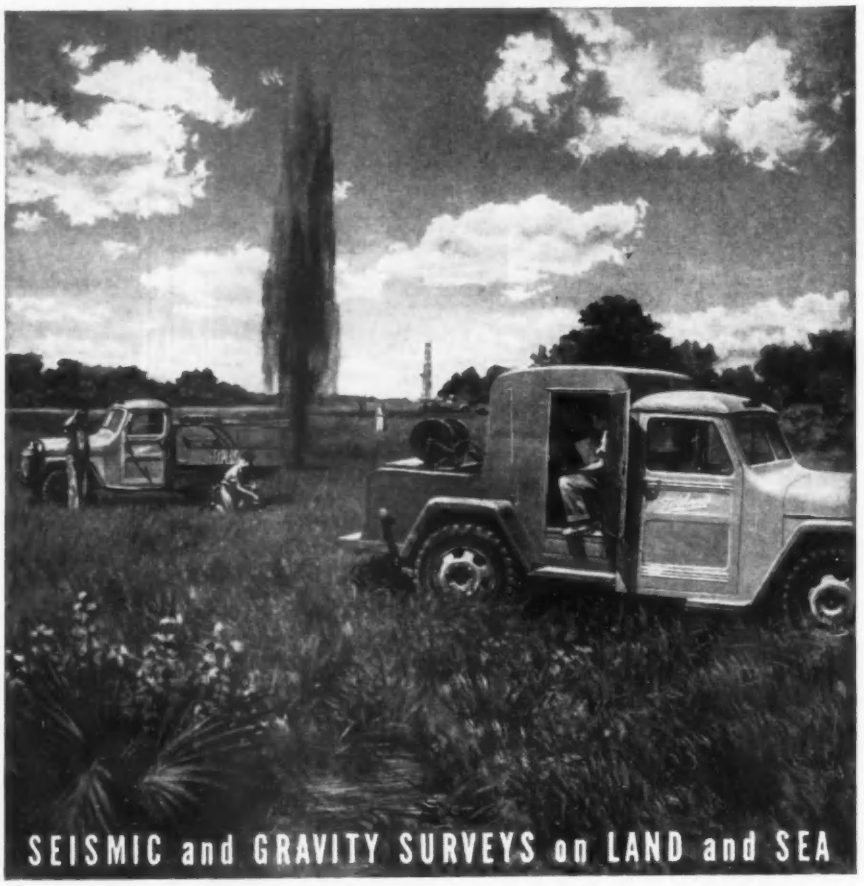
Park County. Ajax Oil Co's Unit 5, NE NE NE 13-57n-98w, pumped 33 barrels oil and 18 barrels water from Tensleep sand, Pennsylvanian 3466-78 feet, completed 5-11-54, TD 3547.

Weston County. Dunbar Drillling Co's Wrench 1, NE NE NW 3-42n-65w, pumped 60 barrels from Newcastle lime, Upper Cretaceous 6133-39 feet, completed 4-24-54, TD 6275.

Unnamed field. F. E. Mundell's Morgan 1, NE SW 16-46-64w, pumped 100 barrels from Newcastle lime, Upper Cretaceous 3864-70 feet, completed 3-3-54, TD 3925.

WYOMING—OIL FIELD EXTENSION

Weston County, Black Thunder field. Western Empire Oil Co's McAvoy 2, SW NW NW 36-42n-66w, flowed 335 barrels from Newcastle lime, Upper Cretaceous 6869-87 feet, ¼-inch, completed 5-18-54, TD 6925.



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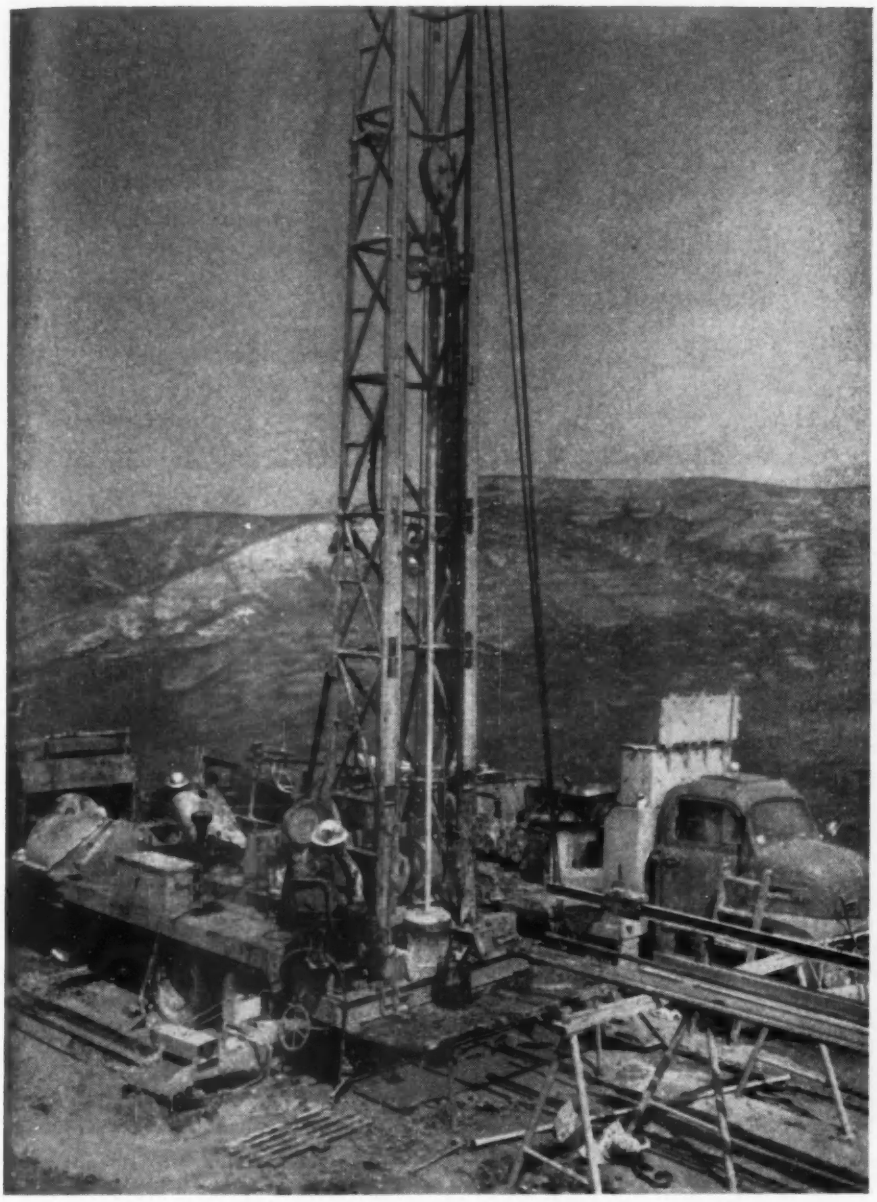


Ultra-Slim Hole Rig Uses 1-1/4-Inch Drill Pipe

Now considered past the experimental stage, these rigs are designed for 3000 to 6000-foot drilling.

By GILBERT M. WILSON, WORLD OIL Staff

SLIM HOLE RIGS, perhaps more accurately described as "ultra-slim hole" or "micro-hole" rigs may well be considered as being past the experimental stage. That nearly all types of formations can be drilled, even under such adverse conditions as steeply dipping beds, faulting, lost circulation, and to depths hitherto thought impractical for such small hole, is convincingly demonstrated in the performance of the slim hole rig owned and operated by Tapco Drilling of Long Beach, Calif.

In operation for about two years, the first 18 months of which were spent largely in field testing of basic rig design, drill pipe, bits and other experimental work, the unit currently is working on a contract basis and is turning in an excellent accounting of itself. It reflects an advanced degree of sound engineering from the standpoint of both practical field operation and, of equal importance, costs.

Editor's Note: In the May issue of WORLD OIL we covered the problems of slim hole drilling. Now here's a report on a still smaller sized hole—the ultra-slim hole and a rig which uses 1¼-inch drill pipe to drill 2¾ and 2⅞-inch holes. At left the ultra-slim hole rig is set up on location.

Detailed descriptions of various components of the rig are to be found farther on in this article. Briefly, the rig is a truck-mounted unit having a 46-foot mast. It uses 1¼-inch drill pipe, 2.20-inch outside diameter drill collars, and bits and core heads of special design which drill 2¾- and 2⅞-inch hole. Although the maximum depth so far reached with the rig is 2200 feet, the basic rig was designed for drilling to optimum depths of from 3000 to 4000 feet and, by making a few changes, including extension of the mast, depths as great as 6000 feet. To date, the rig has drilled in excess of 15,000 feet of hole, most of it of the 2¾- and 2⅞-inch size.

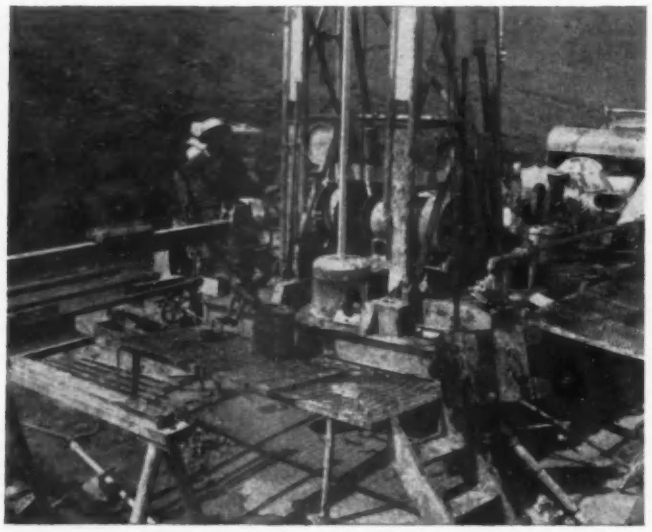
Handled Like Big Rig. Operation of the rig, with few exceptions, is much the same as that of a large conventional rig. It is designed to be operated by a crew of two, driller and rotary helper. Drillers with experience and big rig "savvy" are preferred. Wages paid are the same as those on the larger rigs.

Although the 1¼-inch drill pipe, strengthwise, is equivalent to that used on a conventional rig, the driller on the slim hole rig has to learn early, that he cannot apply the degree of torque that normally would be done in big rig drilling. He must remember that he is turning a drag bit and can-

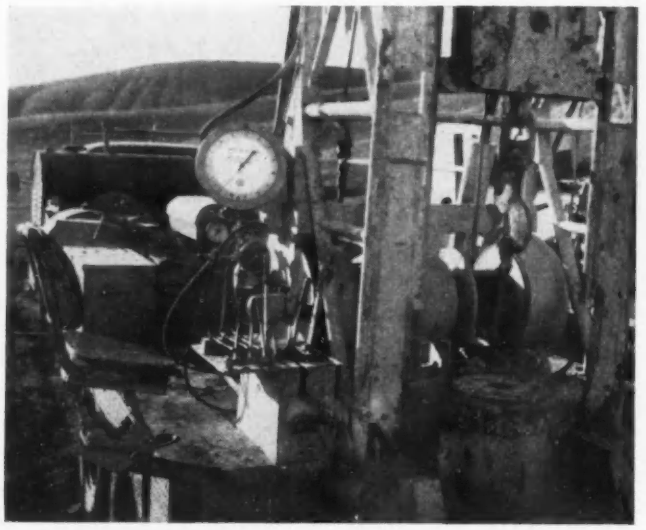
POSITION OF DRILLER enables him to watch returns as they enter shale shaker directly below him. Flexible hose conducts returns from well to shaker.

REMOVING PINS from two of the four guide rollers permits easy detachment (or installation) of drill pipe block from guides which extend length of mast.

DISMANTLED 2¾-inch core barrel which takes 1⅝-inch core. Cutting edge of outer head, also inner head, studded with tungsten carbide inserts. Inner floating barrel projects from outer barrel.

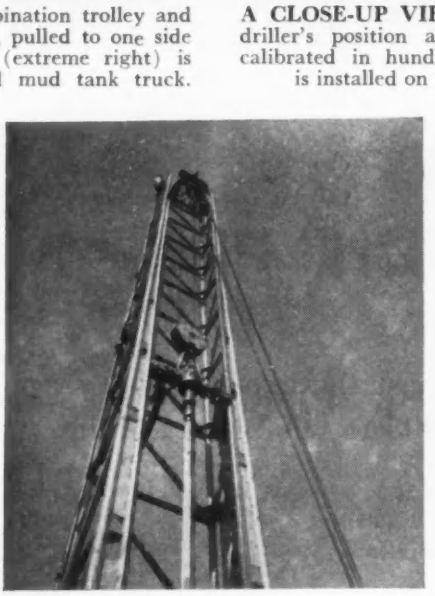


DRILLER AT CONTROLS. Unitized combination trolley and pipe rack at left. Drill pipe block and hook, pulled to one side while drilling, is at right. Mesh platform (extreme right) is thrown across space between drill rig and mud tank truck.

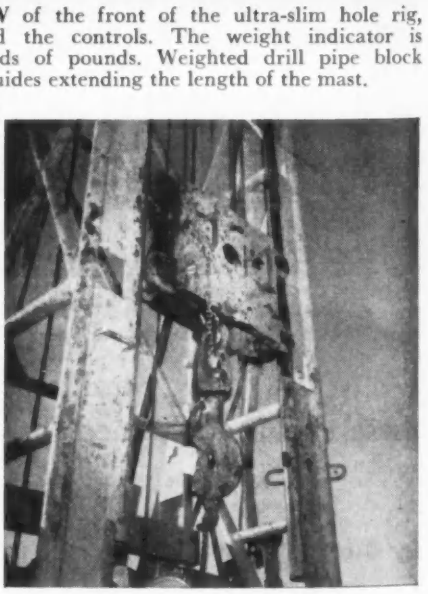


A CLOSE-UP VIEW of the front of the ultra-slim hole rig, driller's position and the controls. The weight indicator is calibrated in hundreds of pounds. Weighted drill pipe block is installed on guides extending the length of the mast.

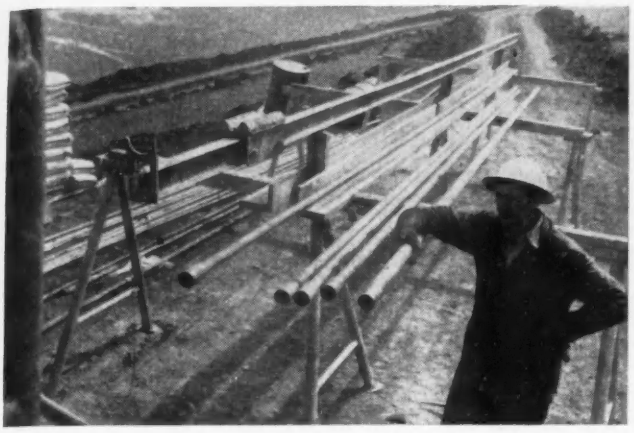
DRILLER AND HELPER rig up at new location. Bed of truck, parked alongside rig, is flat, 500-gallon water tank. Two-compartment mud tank on truck bed holds 470 gallons of mud, 235 gallons on each side.



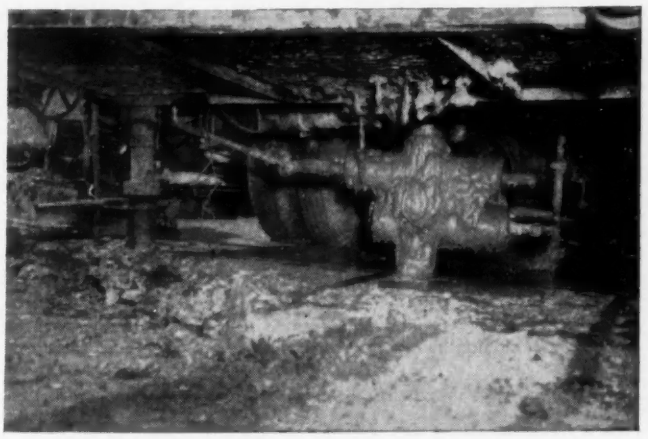
KELLY BLOCK, swivel and two-roller guide being pulled up in mast. Note that guides curve inward near crown. Guides, following track, pull block and kelly into back side of mast, leaving room for drill pipe block.



DRILL PIPE BLOCK and hook shown in operation position on pipe guides extending full length of mast. Block is removed when kelly block is brought down. Four lines normally are strung for both kelly and drill pipe blocks.



UNITIZED PIPE TROLLEY and rack enables one man to rack pipe in singles as fast as it is pulled from hole. Wire, attached to counterweight in rig, returns trolley as soon as helper rolls joint down onto rack. Elevators are used in pulling pipe.



UNDER-RIG VIEW of specially-designed 10,000-pound test combination master gate and pipe ram blowout installed on four-inch surface pipe. Mud return line leading to shaker (at extreme left) is flexible rubber hose.

not rotate too fast as a point will be reached where the bit jumps and skips on bottom. He has much more power available, in relation to his small size string of pipe, than he would have on a large rig. Therefore, he must cultivate and acquire a "feel" for the smaller sizes of pipe and related equipment in order to avoid twist-offs in the event the bit or pipe sticks in the hole. He has to overcome the normal reaction, when sticking occurs, to hit the throttle. Several twist-offs have occurred, as a result of this tendency, before drillers became accustomed to the different conditions.

Some drillers, at first, are wary of carrying much weight on the bit, an initial normal reaction, but this tendency soon takes care of itself as he learns the "feel" of the rig and controls. The weight indicator, calibrated in hundreds of pounds, instead of thousands, is used in much the same manner as the instrument on larger rigs. Under normal drilling conditions, an effort is made to carry a weight equivalent to about 80 percent of the drill collar string weight (whose weight, on this rig is about 2000 pounds, in mud). However, weights as high as 5000 pounds have been carried when drilling very hard shales and siltstones; and as little as 250 pounds when digging in snowbank formations.

Optimum table speed is considered to be in the order of 150 revolutions per minute. It has been found to be ideal for most formations. However, if formations are extremely hard, speed is dropped, perhaps to as low as 50 rpm. Maximum table speed would be 250 rpm.

Through the use of a torque converter in the drive, the driller has an infinite number of hoisting speeds for the drawworks. When starting out of the hole with a full load, he moves the torque converter lever into the low range; then, when a little speed is gained, he merely flicks the lever into the high range for a smooth, uninterrupted flow of hoisting power.

Seated in a comfortable seat at one side of the drawworks, and directly above the shale shaker, the driller has a good command of all operations, including the ability to watch returns on the shaker, and can regulate drilling, hoisting and pump speeds by the controls conveniently arranged in console fashion at his fingertips.

BITS USED on this slim-hole rig are, left to right, (1) core head, showing trimmer head which projects slightly ahead of outer head cutting edge; (2) and (3) partially-worn three-bladed drag bits; and (4) same type bit, but new, being screwed onto sub. All bits are 2¾-inch size.

Pulling, breaking out and laying down pipe in singles by the two-man crew is greatly simplified by the use of an efficient pipe carriage and rack, described in detail elsewhere in this article. Slips are not used on drill pipe; instead, tubing elevators, resembling sucker rod elevators, are employed, and in much the same manner.

Operating Costs Low. Cost-wise, the rig shows some interesting comparisons. Typical of the savings involved in drilling this small a hole, outside of the initial lower costs of basic equipment, pipe and bits, is the mud volume required. The tabular data shows that in 2¾-inch hole, only 7.3 barrels of mud are required per 1000 feet of hole depth. The volume of mud additives required is reduced proportionately. Not only is less material needed, but much faster results are obtained because of the much smaller volume that has to be treated. In one tour, for example, the amount of chemical required might amount to only one or two cups; or perhaps only a quart of so of quebracho or phosphate. The volume of cement needed to plug a hole, or cement surface string (which, incidentally, is done by the rig pump), also is proportionately reduced. Much less water also is required, a consideration of some importance when drilling at remote or difficultly accessible locations where hauling is necessary.

Arriving at a figure for maximum depth attainable by the rig involves some basic considerations. One im-

Applications and Uses of Ultra-Slim Hole Rigs

- An inexpensive means of wildcatting a new geological play.
- A means of inexpensively checking results of a seismic survey. In at least one instance such checking revealed a 1½-mile error.
- A method of checking or exploring for the limits of a proven field. Each slim hole drilled may prove or disprove several locations for development by a conventional rig.
- A tool for inexpensively checking reserves of a lease block; exploring for new sands; determining by coring, best casing points to be used during development well drilling.
- Slim holes may be used for drilling and completing (with two-inch casing) gas wells.
- Slim holes may be drilled for water injection wells in water flooding projects.
- As water disposal wells, slim holes may be drilled inexpensively. Such disposal wells might be cased with two-inch pipe.

portant factor is bit life. If formations are such that a bit makes something less than 100 feet before having to be pulled, optimum economic depth, considering round-trip costs, probably would be 3000 feet or less. If bit life at the bottom of the hole were running around 300 feet per bit, optimum depth might be extended to 4000 feet. These limits are based on time involved in pulling and laying down singles. By extending the mast to enable pulling Range 2 pipe in doubles, standing it up in the rig, these limits (again depending upon formations and, hence, bit life) might be extended to around 6000 feet which, incidentally, is the depth for which the derrick structure, drawworks and pumps were designed originally.

Some of the factors, such as pipe strength, mud velocity ratios, bit loading, etc., for a variety of drill pipe sizes, including the 1¼-inch used on this rig, are presented in the table referred to above.

Special Blow-Out Preventer. The blowout preventer, a specially-made combination master gate and pipe ram unit, is designed for installation in the 34-inch space between ground level and under side of the rotary table. Only 17 inches high, the 10,000-pound test unit screws directly on to four-inch surface pipe and leaves room at the top for a 14-inch high pitcher nipple, the latter having a four-inch return flow line nipple welded into its side. The flow line actually is a four-inch composition rubber hose which conducts the mud directly to the shale shaker, only a few feet away, at the side of the rig. Being flexible, this hose compensates for any small misalignments or changes in height in surface fittings that may exist from location to location.

The usual hookup includes a mud cross immediately below the preventer. Welded into either side of the four-inch body are one-inch nipples and gates, one being the bleeder line and the other the kill line, the latter connected to the stand pipe. The mud cross, with an installed height of about eight inches, is below ground level, being in the shallow cellar provided around the surface pipe.

The blowout preventer rams, above, and the master gate, below, are equipped with universal joint extension handles, the latter projecting out to the side of the rig. The rams have had to be closed on more than one occasion, in the course of drilling some shallow core holes.

V-8 Engine Powers Drawworks, Table. The drawworks and rotary table are powered by a single V-8 automotive type engine located in approximately the center of the truck bed, between the mud pump and the drawworks. The engine has a brake horsepower rating of 25.

Output shaft of the engine is connected into a high-and-low-range automotive type torque converter. This unit, in turn, is shaft-connected to a three-speed gear box, then into a clutch. From this point, the drive is split two ways. One side, going through another clutch, drives the rotary table. The other side, through a sprocket and chain drive, is shaft connected into the angle drive of the double-drum drawworks.

The shaft-driven rotary table is a shop-made ring and pinion type unit having a full-opening six-inch throat. Slips are not used; instead, tubing elevators, of a type and size very much resembling sucker rod elevators, are used. Drill pipe is pulled in singles and handled in much the same manner that tubing is pulled. While one set is on the pipe being pulled, the other set is being taken off the previously-pulled and broken-out joint ready for

Hydraulic Comparison

Drill Pipe	1¼" E.U. Tubing		2" E.U. Tubing		2½" E.U. Tubing		3" E.U. Tubing	
Collar O.D.	2.20"		3.063"		3.668"		4.500"	
Pipe O.D. x I.D.	1.660" x 1.380"		2.375" x 1.995"		2.875" x 2.441"		3.500" x 2.992"	
Wt./Ft.	2.4 Lbs.		4.7 Lbs.		6.5 Lbs.		9.3 Lbs.	
Max. Load	53,500 Lbs.		104,800 Lbs.		146,400 Lbs.		208,000 Lbs.	
Hole Size	**2¾"**	**3⅞"**	**3⅞"**	**4¾"**	**4¾"**	**6"**	**6"**	**6¾"**
Velocity Ratio	2.52:1	8.35:1	2.35:1	6.66:1	2.42:1	4.66:1	2.66:1	3.72:1
Drill Collars	2.25" x 125"		3.125" x 1.250"		3.75" x 1.50"	5.00" x 2.00"	4.75" x 1.75"	4.75" x 1.50"
Wt./200 Ft.	2028 Lbs.		4300 Lbs.		6360 Lbs.	11,200 Lbs.	10,400 Lbs.	10,000 Lbs.
Bit Loading (lbs./in. of dia.)	750 Lbs./in.		1090 Lbs./in.		1340 Lbs./in.	1870 Lbs./in.	1730 Lbs./in.	1480 Lbs./in.
Vol. for 180 Ft./min.	35.2 GPM	90 GPM	69 GPM	125 GPM	106 GPM	204 GPM	175 GPM	245 GPM
△P—Drill Pipe	15 Lb./100'	78 Lb./100'	8.3 Lb./100'	29 Lb./100'	6 Lb./100'	18 Lb./100'	4.7 Lb./100'	8.4 Lb./100'
△P—Drill Collars	58 Lb./100'		86 Lb./100'		76 Lb./100'	58 Lb./100'	80 Lb./100'	82 Lb./100'
Bbls./1000' open hole	7.3 Bbls.	14.9 Bbls.	14.9 Bbls.	22 Bbls.	22 Bbls.	35 Bbls.	35 Bbls.	45 Bbls.
Psi at 6000' Thru Pipe and Drill Collars	(3000') 536 Psi		645 Psi		502 Psi	1156 Psi	433 Psi	644 Psi

Table comparing engineering data and calculations involved in the consideration of four sizes of drill pipe, including the 1¼-inch size used on the present slim-hole rig. Instrumental in selecting drilling string and slush pump presently in use, data was calculated by company to aid in arriving at maximum size hole attainable with minimum capital outlay.

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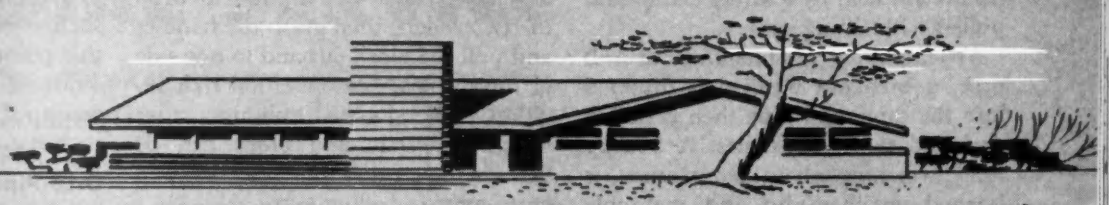

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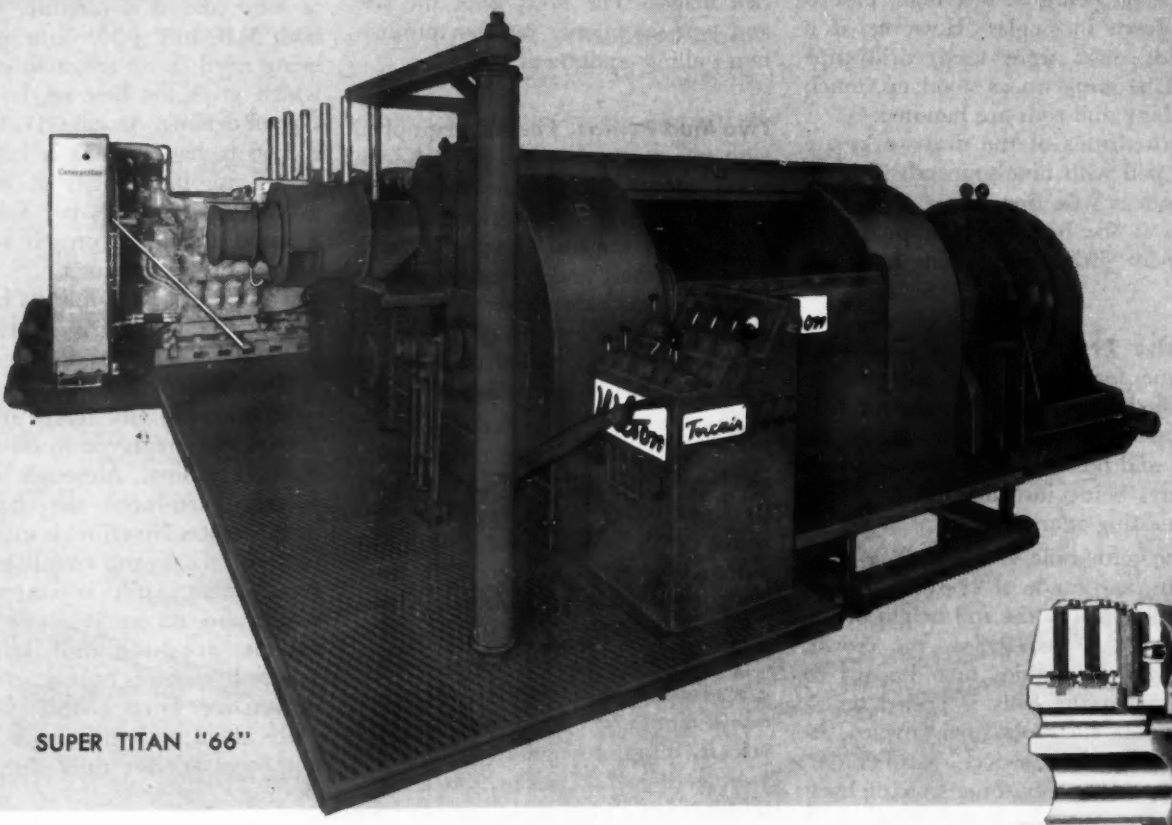
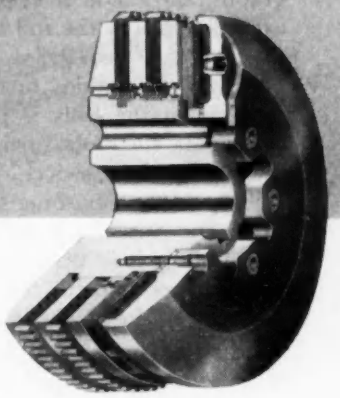


SUPER TITAN "66"



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use on the next one. One man easily handles both elevators.

Drill collars are handled in the conventional manner. Pulled in singles, collars are held by a safety clamp and pulled with lifting subs.

When pulling and breaking out drill pipe, a breakout bushing is dropped into the table and pipe then is pulled and laid down in singles. A backup tong, weighing about ten pounds, is latched on the joint and the table then turned to spin it out. When going in the hole, pipe is made up with a 24-inch pipe wrench. Air tongs could be used if desired, however. The mast of this rig being 46 feet high, pipe is laid down in singles. However, if a 90-foot mast were used, drill pipe could be hung up or stood up, much as tubing and rods are handled.

Both drums of the drawworks are equipped with nine-sixteenth inch independent wire line center rope. One drum is for hoisting drill pipe; the other for lifting and setting back the kelly.

Blocks Travel Along Guides. Unique features of the rig are the modified travelling blocks and the pair of tracks or guides along which the kelly and hoisting blocks travel; both features being instrumental in speeding hoisting operations.

The guide rails, visible in the photographs, and made of 2½-inch tubing, extend to nearly the full height of the mast. A few feet below the crown, however, the guides turn inward so that, when the kelly is pulled up to that point, the block turns inward, allowing the block, swivel, swivel guides, kelly and rotary bushing to hang back in the rig out of the way when drill pipe pulling is in progress. Use of the guides also eliminates undesirable swinging of the blocks.

Both the swivel and the drill pipe hoisting block are equipped with concave rollers which travel along the guide rails. These offset-hinge mounted rollers are so mounted that by pulling a pin, the roller will drop down and inward a few inches, allowing the unit to be installed on or taken off of the track. The swivel guide employs two rollers, one on each side. The travelling block is equipped with four rollers, and, to provide extra weight to speed descent of the block, the block is faced on each side with a square one-inch flat steel plate. On this block, the two rollers on one side are equipped with the removable pins to permit installing on or removing from the tracks. A pair of steel handles welded to the outer face of the block makes it relatively easy for a man to drop the two rollers, then grasp the handles and pull the block out and to one side of the rig floor, an operation that requires only several minutes, after which the kelly and block can be brought down and the kelly screwed on to resume drilling.

For most drilling and hoisting operations, four lines are strung. The swivel is shop-made and blocks are short-coupled so as to require less derrick height. The hook is of the size and type commonly used on production pulling equipment.

Two Mud Pumps. The rig is equipped with two mud pumps; a 5- by 8-inch pump mounted crosswise of the bed, just ahead of the drawworks engine. It is driven by the truck engine through a take-off shaft and transmission to a quadruple chain drive. The truck engine, of conventional 160 horsepower rating (35 brake horsepower) is of 270 cubic inch displacement.

The auxiliary pump, a 4- by 5-inch unit mounted on the combination water storage and mud-mixing tank truck is powered, through a single chain drive, by a small four-cylinder automotive type engine. This unit, ordinarily used for mud mixing, also is used occasionally for circulating.

For most normal drilling the pump is operated at a speed that will maintain a minimum mud return flow rate velocity of approximately 180 feet per minute. For the 2¾-inch holes currently being drilled, this means a circulating rate of 35.2 gallons per minute.

For this optimum mud velocity of 180 feet per minute, the calculated pressure drop (ΔP) inside the drill pipe is approximately 15 pounds per 100 feet; in the drill collar string, approximately 58 pounds per 100 feet.

The shale shaker, a small but efficient unit equipped with a 20-mesh screen, is shop-made and is so positioned that the driller, sitting at his controls immediately above it, can watch returns. The unit is driven by a small electric motor. As it leaves the shaker, mud flows along a 12-foot unitized steel ditch placed at ground level beside and running parallel to the drill rig truck. At the end of this ditch, it turns through 90 degrees and flows through a longitudinally-split length of eight-inch casing, beneath the rig, to the suction pit which is dug in the ground immediately below the suction end of the mud pump. From this point, the pump picks it up and sends it through a relief valve-equipped two-inch line up to the two-inch stand pipe in the rig.

Drill Pipe 1¼-Inch. Drill pipe used on the rig is 1¼-inch OD externally upset tubing. Although the present string is a mixture of both Range 1 and Range 2, it gradually is being replaced entirely with Range 2. Grade of steel also is a mixture, including both N-80 and J-55. Both grades are being tried in an effort to determine which gives the best service for this type of drilling. Actual OD of the pipe is 1.66 inches and ID is 1.38 inches. Made up, the weight of the string averages 2.4 pounds per foot. It has a rated tensile strength of 53,500 pounds per square inch.

Tool joints, or couplings, having an outside diameter of 2¼ inches, have a standard ten-thread, round three-fourths inch-per-foot taper, the same type of thread (though of smaller diameter) as employed in oil well production tubing. Although couplings are not hard-faced, they have given good service. No effort is made to salvage or reface worn couplings as their replacement cost is comparatively small; also, no one is as yet set up to volume produce drill tubing tool joints. It requires only a few minutes to remove worn couplings and replace them with new ones and it is not necessary for drill pipe to leave the rig.

The 2½-inch square kelly is 25 feet long, although consideration is being given to extending the mast and using a 35-foot kelly and all Range 2 drill pipe.

Drill collars used are 2.20 inches OD by 1⅛-inch ID and are 22 feet long. Equipped with double boxes, collars are connected with double-pin wear subs of 2⅜-inch outside diameter. Threads are six-thread modified union tool of the company's own design. Under normal drilling operatings, ten collars are carried in the string, the 222 feet of collars weighing, in air, about 2500 pounds, and 2000 pounds in mud.

Wear and replacement of the double-pin collar subs, as in the case of drill pipe couplings, is considered

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from the standpoint of expendability. Because of the small sizes of the subs, the company considers it cheaper to cut new ones than to have the worn ones built up; also this procedure means less down time of the string, since a complete set of replacement subs can be carried in a small tool box and kept with the rig at all times. That the drill collar thread design has proved satisfactory is attested by the fact that in the year or so during which these collars have been used, there has been no need, as yet, to service any of the threads.

Drag Bits of Own Design. Bits, both drilling and core head, employed thus far are of a design worked out by owners of the company. Although patents have been applied for on the basic design, changes still are being made and incorporated in the design, as experience is gained with various types of formations and drilling conditions encountered. The two principal sizes being used are 2¾- and 2⅞-inch. It is a three-bladed conical-shaped drag bit with carborundum inserts placed in the leading edges of the blades. It has three mud courses, each of which opens out in the hollow between blades. The orifices are designed for a capacity equal to that of the drill string and with a pressure drop of something in the order of 75 pounds per square inch.

The bit in its present form has turned in some impressive penetration records, one instance being that of a bit which made 750 feet of hole before being taken out of service. It appears, based on data gathered from some areas where comparisons were possible, that performance of the bit is competitive with that of standard rock bits. In one California area, where drilling was being done in formations being drilled also by a nearby larger rig, about 500 feet of hole was made with one bit; practically the same as that turned in by the larger rock bit of the big rig.

The core head, also of a design perfected by the company, is equipped with carborundum inserts. It cuts a 2¾-inch hole and 1⅝-inch core. The inner barrel is full-floating and has an OD of 1¾ inches. OD of the outer barrel is 2-5/16 inches. During coring, mud passes between the inner and outer barrels and emerges through four three-sixteenth inch ports. A feature of this core head which has proven to be particularly advantageous is the trimmer head, a short carborundum studded core-cutting tube which screws inside the outer shell of the head. This trimmer head, which projects ahead of the outer head by perhaps three-quarter-inch, and which cuts and trims the 1⅝-inch core, easily is unscrewed and replaced whenever the teeth begin to get dull or lose gauge. The barrel shown in one of the accompanying photographs actually is a ten-foot unit, but an 18-foot barrel normally is run.

In normal operations and if considerable coring is planned for a particular hole, 2⅞ hole is drilled, then when coring point is reached, ratholing ahead with the core barrel which drills 2¾-inch hole. After the core barrel reaches bottom, and circulation is started, a ball is dropped, diverting circulation to between the inner and outer barrels and following which, coring is started.

In the design, use and maintenance of the coring equipment, the operator, has stressed the importance of making every component easily removable, serviced and replaced, if necessary, without leaving the rig.

Mast Has Pulled 37,000 Pounds. The tubular steel mast is 46 feet high, from crown to top of rotary table. It has a 40,000-pound rating and, in at least one instance, 37,000 pounds has been pulled without any visual affect on the structure. The rig is a commercially manufactured unit, modified by the operators to suit their particular needs. The mast is raised and lowered hydraulically in conventional manner. No guy lines are required for normal operations.

One-Man Pipe Racking System. The drill pipe rack and tailing device, also designed by the owners to meet the specialized needs of the rig, combines efficiency with simplicity; also is so planned that it readily is knocked down for hauling between locations.

Illustrated in one of the photographs, the unit consists essentially of three horses, about four feet high, made of two-inch pipe. The horizontal member of each horse is an inverted length of channel iron, atop which is bolted a 2 by 6-inch wooden pad to cushion impact of drill pipe dropped upon it. Running the full length of the rack is an I-beam on which rides a four wheel carriage. Atop this carriage is a wooden saddle device on which the pin end of the drill pipe is rested when the latter is placed upon it. A fixed yoke of steel plate is welded to the front end of the I-beam. Extending the full length of the rack and on each side, almost directly below the I-beam, is a 2 by 6-inch plank which serves as the "walk" along which a joint is skidded as it is pulled up in the derrick when going back in the hole.

Efficiency of this rack, making it possible for the rig to be operated with but two men, permits pipe to be racked as fast as it can be pulled and broken out. In operation, the pipe is handled in the following manner:

The instant a joint is broken out and hoisted clear, the rotary helper grasps the pipe and, with a half turn, swings it out, placing the pin end on the cart. The driller releases his brake and the joint rapidly slides out to the limit of its travel, the box end dropping into the steel yoke fixed on the near end of the I-beam. The helper releases the hook from the elevator bail and swings the hook back to engage the other set of elevators that previously had been placed under the coupling of the joint still in the hole. While the driller pulls the next joint, the helper disengages the elevator just released, lifts the joint out of its cradle and rolls it over the side and down on to the rack. By the time he has finished, the new joint is out of the hole and he can latch his elevator beneath the emerging collar. The weight is set down on the elevator and the joint then is broken out with the shortened 24-inch wrench. A light wire, one end fastened to the cart, and the other end to a counterweight mounted on the side of the rig, retrieves the cart when the joint is rolled off of it.

Height, above ground level, of the trolley is between 5½ and 6 feet. Pipe rack height is approximately four feet. Multiple layers of pipe may be racked merely by laying boards across and running short lengths of one-inch pipe up through the sockets permanently attached to the channel iron rack members.

Some idea of the speed with which pipe can be pulled and racked can be gained from the following timed, typical run: Approximately 2100 feet of drill pipe, including the ten drill collars, was pulled and laid on the

rack in about three hours. Pulling drill collars requires considerably more time since a safety clamp has to be installed on each joint and a lifting sub screwed into the box. A good share of the above pulling time was taken up with the collars.

The combination mud and water tank truck normally is parked parallel to and several feet away from the drill rig, a steel grating walkway being dropped across the intervening space. The truck bed has a false bottom, being made into a flat steel tank with a capacity of 500 gallons of water. Water supply at the rig is augmented by a two-wheeled tank trailer which the pusher pulls with his three-quarter-ton pick-up truck. This trailer, with a capacity of 325 gallons, brings water supply available at the rig to 825 gallons, an ample supply for all normal operations, based on the average consumption rate, for normal drilling, of about 100 gallons per tour.

The rectangular open mud tank, divided into two equal compartments, has a capacity of 235 gallons in each side. Behind the cab of this auxiliary truck is mounted a series of steel cabinets and bins in which are carried spare parts, tools and miscellaneous equipment.

Speed and efficiency are not limited to only the drilling operations. The equipment is designed also to require a minimum of tearing out and rigging-up work. A typical move, from release of rig to spudding-in on another hole two miles away, has been made in eight hours. This includes tearing out and reinstalling the blowout preventer, mud ditches, hauling of drill pipe (with the pick-up; 200 feet per load), bringing water to the new site, installing suction lines, mixing mud and spudding-in. Use of fast-acting couplings and levelling screw jacks aids in speeding moving operations. One of the most important operations in rigging-up for a new hole is in the spotting of the rig over the precise center of the four-inch conductor pipe, hole for the latter generally being drilled and pipe set beforehand by another shallow hole rig. When a 2⅞-inch bit is run in four-inch conductor pipe, centering of the rig is important.

Do Own Cementing. The rig is equipped to do its own cementing work, using the existing pumping equipment. Typical cementing jobs done include cementing of 200 to 400 feet of surface pipe, a three or four-inch string, whenever that string is not previously set before moving on to a new location; also routine plugging or abandonment work that may be required by the State Division of Oil and Gas.

The rig carries its own fishing tools, consisting essentially of taps and spears. Due to the small hole clearance, it sometimes is impossible to wash-over a stuck string of pipe and a tap or spear usually does the job satisfactorily.

Fishing Experience. Remarkably little fishing trouble has been experienced so far on this rig, despite a wide variety of drilling conditions. Fewer than a half-dozen fishing jobs have occurred in the past year, and, even in these cases, only one fish, a core barrel, ever has been left in the hole. In one hole, the deepest yet drilled by this rig, either partial or complete lost circulation was experienced from a deth of about 25 feet down to total depth of 2200 feet. Pipe was stuck twice, but was freed in each instance. The alternating sand and shale formations drilled were faulted and very steeply dipping (up to 85 degrees). In spite of steep dips and lost circulation problems, the driller carried 1500 pounds, about 75 percent of his available collar weight, on the bit and still stayed within limits of five degrees; usually around three degrees. This performance compares with that of a conventional rig, drilling nearby and in the same formations, where the driller, to maintain reasonably straight hole, could not carry but 1 to 1½ tons weight on his bit (a shoulder bit) and seven-inch collars while drilling 10⅝-inch hole.

One explanation is that on the large rig, the collars could bow a distance of 3⅝-inches, whereas in the slim hole, collars could bow but about three-eighths inch; this small clearance providing a stabilizing influence on the string which usually means a straighter hole.

Several twist-offs have occurred, but these generally have not created any serious problem. In at least one instance when a twist-off occurred, the free pipe was pulled, rerun with a tap, the stuck portion pulled, the string made up again and bit set on bottom ready to make hole, all in about two hours time. Fast time such as this is possible because of the speed with which the light pipe can be handled, and by having the necessary fishing tools right at the rig. Immediate availability of such tools means less likelihood of settlings dropping down, or cave-in of formations occurring, with consequent less chance of more serious trouble developing.

Expendability Attitude Necessary. On the matter of fishing in ultra-slim hole drilling, it should be said that the operator must adopt a somewhat different attitude, as compared with big rig operations, when confronted with a fishing job. Reduced to its simplest terms, this attitude is one of "expendability." This means that recognition must be given to the fact that the cost of equipment lost in the hole usually is of such low value, comparatively speaking, that he can not afford to economically fish more than a few hours or, at most, a day or two.

Depending upon depth of hole and amount of pipe in the hole, it can be seen that, with 1¼-inch drill pipe valued at around 65 cents per foot, not much time could be afforded in fishing for it. The operator, knowing his costs, should decide quickly on where to draw the line between fishing and setting a whipstock and start making new hole.

In designing the present rig, the owners have recognized this attitude of expendability. The replacement, rather than rebuilding, of drill pipe couplings is one such example. Replacement, instead of rebuilding, of drill collar connectors, is another. The rig engines, when starting to show effects of wear, using oil, etc., are simply replaced, for it generally does not pay to spend much time, particularly when rig operating time may be affected, to make anything but minor repairs on the comparatively small power plants. In other words, everything about the rig, the equipment and crew, is aimed at one objective: make hole and make it fast, consistent, that is, with good operating practices and recovery of the subsurface information desired.

Ultra-Slim Hole Services Available in West Coast Area

A SURPRISINGLY wide variety of services already is available for ultra-slim hole use.

Electric logs are available in a variety of sizes. One, probably the smallest, has the sondes inside a one-inch cable and is lowered with a 1⅝-inch sinker bar. The

Continued on Page 152

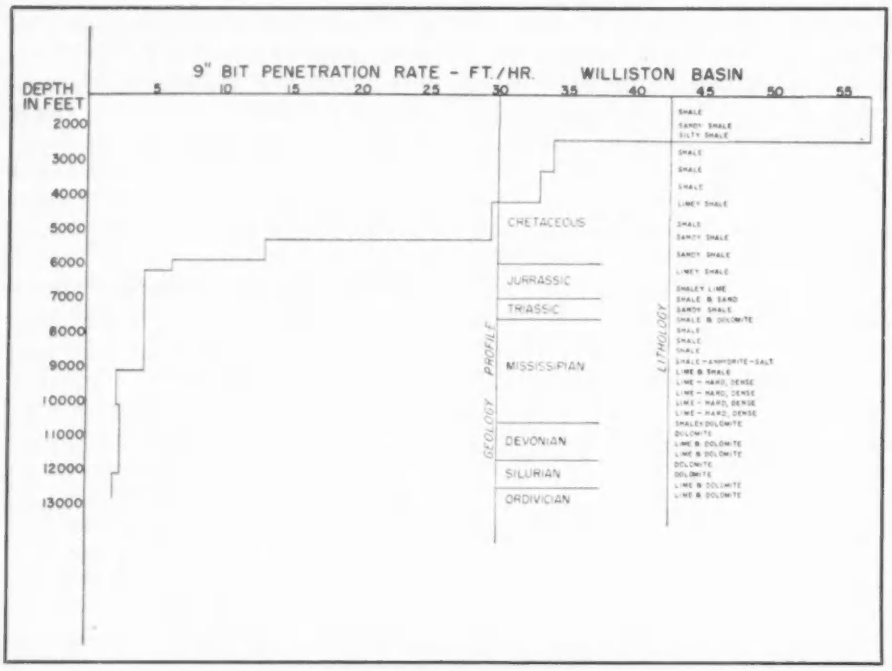

FIGURE 1

12,000 Feet of Open Hole!

Sun Oil's wildcat in the Williston Basin was so "engineered" that the operator was able to make more than two miles of open hole without setting the usual intermediate string of casing. The saving . . . $40,000.

By CHARLES C. ROSSMAN, Sun Oil Company, Denver

RIGID CONTROL on the mud properties, particularly the water loss, eliminated the need for setting an intermediate casing string in a Sun Oil Company wildcat drilled 10 miles northwest of Sidney, Richland County, Mont. The well was projected as a 13,000-foot test of the Ordovician and was spotted close to the center of the Williston Basin.

Problems. Before drilling commenced, and in order to avoid all possible hazards attendant to locating a wildcat in a little-known region, the following problems were considered:

1. Adequate equipment and personnel.
2. Water supply so as to eliminate freezing hazards.
3. Winterizing so as to eliminate downtime due to cold weather.
4. Hole protection, since the first 7000 feet to be drilled was anticipated to be bentonitic shales.
5. Elimination of the expense of an intermediate casing string if at all possible.
6. A mud program to cope with the salt, anhydrite and gypsum sections expected to be encountered.

Selecting adequate equipment to do the job, although involving routine engineering considerations, was done with special study being given to the condition of the drill pipe, size and capacity of the mud pumps, and adequate blow-out protection. All proved adequate.

Water Problem. The water supply problem was partly solved by drilling a water well on location. The well proved satisfactory for the first 124 days of operation after which the well went dry and it became necessary to haul water from 12 miles away. A total of 275 barrels of water per day was hauled to the rig at a cost of 30 cents per barrel. It is anticipated that in many sections of the Williston Basin, the problem of adequate water will be encountered.

After the drilling rig was erected it was entirely enclosed (with the exception of the mast) with a frame and corrugated iron structure. All lines carrying water or mud were protected by adjacent steam lines. This precaution was taken to eliminate any down time due to line freeze-ups.

The last three problems mentioned above can very well be grouped together under an adequate mud program. Advantage was taken of the limited experience of the mud engineers in their two years of scattered operations since the first discovery well in North Dakota. Many things had been tried in an effort to maintain a stable mud, and to the date of spudding this well a gypsum base mud[1] had proved most satisfactory in keeping hole trouble to a minimum. The mud program will be discussed later.

Drilling Program. The drilling program was set up as follows:

1. Set approximately 1000 feet of 13⅜-inch surface pipe.
2. Drill out below surface pipe with a nine-inch hole to total depth.
3. Mud to be fresh water to just above first anhydrite stringer at approximately 6800 feet. Switch mud to gypsum base to total depth.
4. Casing program—no intermediate string to be run unless hole conditions dictated otherwise.

Hole Protection Meant Savings. The hole protection was maintained by keeping a rigid control on the mud properties, particularly the water loss, which was rarely allowed to exceed six cc down to 10,000 feet and from then to total depth it was kept below five cc. This control was accomplished by performing frequent mud checks daily, and by so doing the drilling personnel became more and more mud conscious.

It was felt that this mud program contributed materially toward the elimination of an intermediate casing string and numerous fishing jobs which had been the experience of operators in the Williston Basin prior

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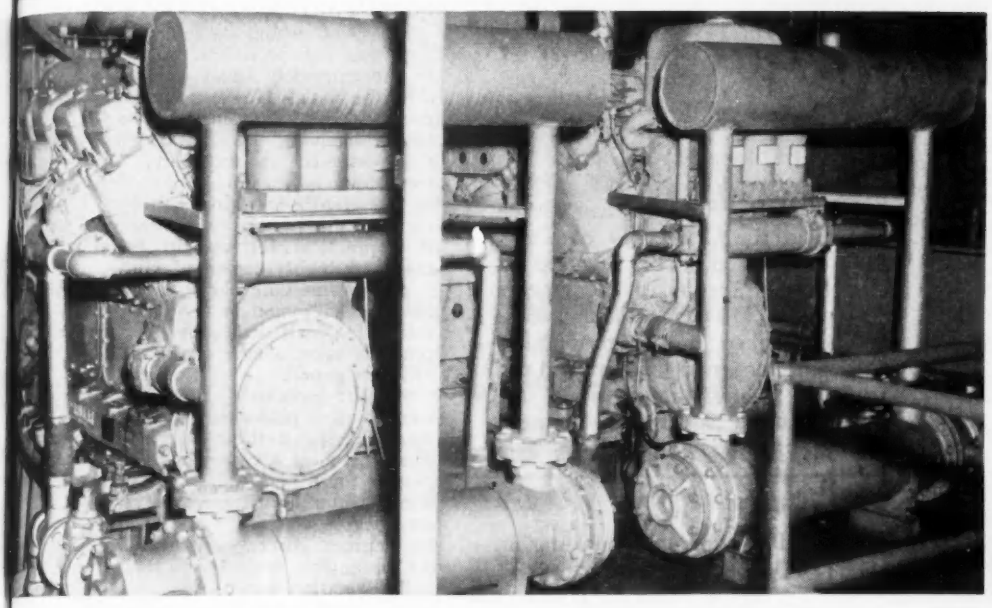

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J. O. SHARON, Drilling Superintendent, Continental Drilling Co., Inc.

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to the drilling of this well. Although the mud cost (as shown in the general statistics) exceeded its appropriation by approximately $10,000, the elimination of an intermediate casing string costing in the neighborhood of $50,000 was accomplished, thus effecting a saving of $40,000.

One of the major problems yet to be solved in this area is that of bit penetration rates. The formations below 8000 feet are for the most part dense, tight, hard limestones. There are several factors affecting this problem. One is the loss of energy in overcoming hole and fluid friction which is to be expected with increasing depth. Another is the nature of the drilling fluid itself. The gypsum base mud is inherently a high gel mud. This, combined with the bottom hole temperatures encountered in this area (a gradient of as much as three degrees per 100 feet of depth) puts a greater load on the mud pumps and cuts down the efficiency of removing cuttings from the face of the bit.

Bit Penetration. The drilling experience in this hole was that the bit penetration seemed to be constant whether the drilling weight was 25,000 pounds or 40,000 pounds. Consequently, using the lighter weight, bit runs of from 25 to 30 hours were not uncommon. Figure 1 illustrates rates of penetration in the formations encountered while drilling.

Unless greater penetration rates are attained in future drilling to this depth in this area, a rigid mud program to "protect the hole" will be a requisite for the more successful type operations.

The present trend is to drill a larger hole to about 10,000 feet through the Mississippian, set an intermediate casing string, and then drill on to total depth. This is a logical step to protect the upper hole, but results in even slower drilling rates to the 10,000 foot mark.

Statistics. The general statistics on this drilling operation follow:

Spudding Date—October 13, 1952

Surface Casing—967 feet of 13⅜-inch pipe.

TD	October 31	6030
	November 30	8220
	December 31	9400
	January 31	10,390
	February 27	11,310
	March 31	12,480
	April 10	12,637

About the Author

CHARLES C. ROSSMAN is a native of Pleasantville, N.Y. He joined the marketing division of Sun Oil Company in 1941 in Atlantic City, N.J. During the war he served overseas in Ireland, England, North Africa, and Italy. After the war he attended the University of Tulsa and received a B.S. degree in petroleum production engineering in 1950. He rejoined Sun and worked in the production department in Oklahoma and the Rocky Mountain divisions. At present he is district engineer for Sun at Seminole, Okla.

Elapsed time from spudding in—179 days

Number of nine-inch rock bits used—79

Number of feet cored—1000

Number of drill stem test runs made—16

Total down time, fishing—five days or 2.8 percent of total elapsed time.

Mud cost to 6800 feet—$0.17 per foot

Mud cost, 6800 feet to TD—$5.77 per foot

Mud cost from surface to TD—$2.76 per foot

Considering the mud cost item, it is readily seen that the gypsum base mud is expensive, but also considering the fact that little or no hole trouble was experienced during the entire drilling operation it was felt the additional cost was justified. Inasmuch as this was a wildcat operation, it was not known how long the hole would be worked before completion. Therefore, no sacrifice in cost was made to maintain the most desirable mud system which would minimize hole trouble.

REFERENCE

[1] "Drilling Mud Program," W. F. Huddleston, *Pet. Engr.*—June 1952.

—The End

Ultra-Slim Hole Rig

Continued from Page 149

only disadvantage, and this is a minor one, in use of this cable type log is that the sinker bar prevents recording of the last five feet of hole. Other electric logs range in size from 1⅞-inch, 2¼-inch and on up to conventional larger sizes. Cost of running one particular make of log, one which gives two curves, S.P. and Normal, is approximately one-third that of a conventional size log. For core-hole work there are numerous instances where, for correlation work, two curves give ample information.

Side-wall coring in 2¾ and 2⅞-inch hole has not been done successfully due to the extremely small working space inside the hole. However, oriented punch cores, taken off bottom, can be taken. Such cores, involving use of a single shot picture oriented to the core, usually are from four to six inches long by one-half to five-eighths-inch in diameter. The nature of the punch core, however, makes it impractical for use in conglomerate, cherts or highly cemented sandstones.

A wire line core barrel, it is understood, has been designed for and has been used inside 1¼-inch drill pipe. This barrel reportedly takes a core about the size of an ordinary pencil.

A drift indicator is available which is run in on a piano wire line. This instrument, having a three-fourths-inch outside diameter, is of a type which, when left on bottom for a period of five minutes, burns a hole in a light-sensitive paper to indicate degree of drift, up to a maximum of ten degrees. Direction of drift, however, is not obtainable with this instrument.

A formation tester of a size permitting it to be run inside 2¾-inch hole has been made available for slim hole operations. This unit, having an outside diameter of 2¼ inches, is a conventional side-wall packer tester scaled down to a size permitting its use inside small hole. One of the interesting applications of this tester has been its use in making swabbing tests of formation fluid in water-well drilling. Where a test of water quality, plus some indication of its rate of flow, before pipe is set in the hole, the packer is run in and expanded immediately above the zone in question. A swab then is run inside the drill pipe to bring formation fluid to the surface for examination.

String shots have been used satisfactorily inside the small drill pipe. A magnetic fishing tool, capable of recovering small pieces of junk weighing up to about a pound, also has been run inside 2¾-inch hole. A releasing type bulldog spear also has been made available for use on 1¼-inch drill pipe.

A left hand die collar was employed in an interesting manner on one fishing job on the present rig. With eight joints of drill pipe, eight drill collars and a core barrel in the hole, a left hand die collar was run in on drill pipe, the couplings of the latter being spot-welded as it was run in so the string could be rotated to the left. The run proved successful for, as it happened, the fish unscrewed just above the core barrel and pipe, drill collars and the core barrel swivel were recovered in one run. Spot welding of the drill pipe couplings did no harm to the string for the welds were burned off and the string returned to normal service. The core barrel was left in the hole, the only fish that so far has been lost in the 15,000 feet or more of hole drilled to date.

—The End

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Experience indicates that proper treatment is critical because of the long exposed sections of shale and bentonite. Here are advantages and disadvantages of various . . .

Drilling Mud Programs In the Williston Basin

By HOMER B. BROWN, JR., Division Manager, Mud Control Laboratories, Casper, Wyo.

PLANNING AND PROPER maintenance of drilling fluid properties is highly important in resolving the problems associated with Williston Basin drilling. In order to develop mud programs for this area, consideration must be given to the lithology (Figure 2) that will be encountered in the well to be drilled, and from this information take note of the following items:

- Quantity of anhydrite or gypsum present.
- Quantity of salt or other evaporites present.
- Amount of upper Cretaceous shales and bentonites to be drilled.
- The zones of possible loss of circulation.
- Hydrostatic pressures to be maintained with the drilling mud.

In every area of the Williston Basin it is necessary to cope with a long exposed section of Tertiary and Cretaceous shales and bentonites. Small sand zones will be interspersed in these upper shales. The mud problems encountered while drilling this section of the hole will include a mud weight buildup, due to drilled solids, and a caving shale section.

In most areas, a light chemical treatment is followed to control the viscosity, gel strengths, filtrate loss and filter cake characteristics. This chemical treatment will consist of caustic soda and tannins or phosphates and tannins. The thixotropic properties of the mud may be varied to conform to the upward annular velocity of the fluid, so as to assure complete removal of formation cuttings and cavings from the well bore.

The Marsh funnel viscosity will be maintained at from 32 to 45 seconds per quart, with correspondingly low gel strength characteristics. The filtrate loss will vary from 8 to 15 cubic centimeters on the 30-minute API test. It has been the practice to convert this light chemically-treated native mud to a mud which will tolerate the presence of the anhydrite and/or salt contaminants present. This "top-hole" mud is converted to one of the following types of mud systems prior to drilling into the Triassic Spearfish formation:

1. Gypsum base muds. (Figure 3A.) The type of mud in most general use throughout the basin is gypsum base mud. This system is a calcium sulfate saturated mud which will tolerate any anhydrite or gypsum drilled without deleterious effect upon the mud properties.

Salt can be drilled with this mud, with the mud characteristics being controlled by the addition of pre-gelatinized starch and salt water clay. It is necessary to carefully control the viscosity with water or salt water clay, and to maintain the filtrate loss characteristics with starch and starch preservatives as the salt is being drilled.

The procedure for this conversion is to add 3 to 4 pounds per barrel of gypsum (calcium sulfate) to the native mud. Water is used to control the viscosity during the gypsum addition. Filtrate loss properties are then controlled by the addition of from 4 to 6 pounds per barrel of pre-gelatinized starch, depending upon the filter loss properties desired.

It has been the practice to add one-half pound per barrel of sodium carboxymethyl cellulose to the mud system to assist in the control of the filtrate loss and filter cake properties. Addition of from ¼ to ½ pound per barrel of starch preservative prevents fermentation of the organic starch additive.

The maintenance program will include use of water or salt water clay

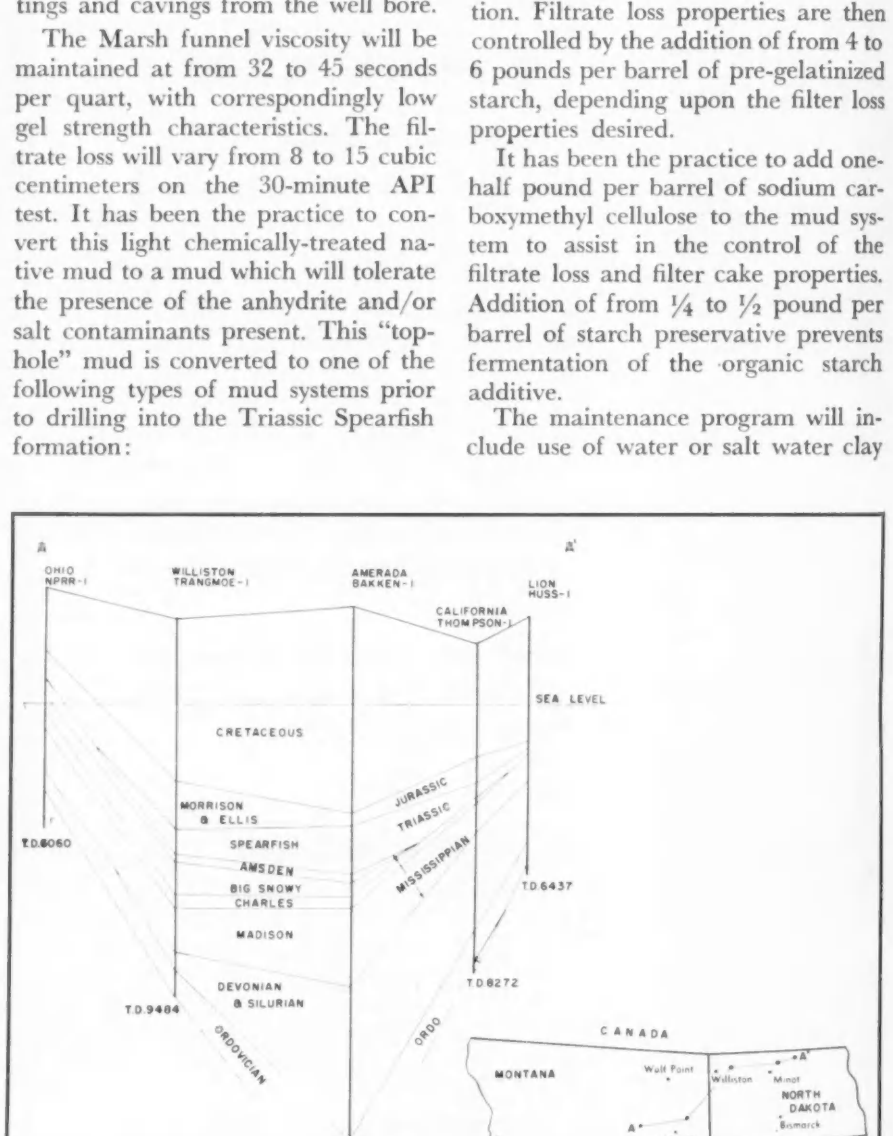


Fig. 1—East-west cross-section Williston Basin.

to control the viscosity between 40 and 65 seconds per quart as required. Since this type of mud retains drilled solids and sand, due to the high, flat gel strengths, it is necessary to control the mud weight or density by jetting the system and rebuilding the mud volume.

The initial gel strength will be from 30 to 45 grams, with the ten minute gel strength varying from 40 to 55 grams as measured with the stormer viscosimeter.

The filter loss will be controlled at the desired point with starch. The cost of the conversion will be approximately $1.50 per barrel of mud, with the daily maintenance costs being controlled by the amount of water dilution which proves to be necessary to control the mud weight.

The mud weight should be kept as low as possible to prevent possible loss of circulation. It is important to keep between ¼ and ½ pound per barrel of preservative in the mud system at all times. Some operators have added crude oil to gypsum base muds, but with little effect other than a temporary reduction in mud weight. The oil becomes mechanically mixed with the mud, but does not become emulsified. The crude oil added is quickly lost to the shale portion of the hole, due to the lack of emulsification, and could cause some caving or sloughing.

Gypsum muds are corrosive to drill pipe, pumps and other metal equipment. These muds have a tendency to entrain air due to the inherent high gel strength characteristics. It would be difficult to control the properties of this mud if high pressure gas zones were drilled. Figure 4 shows typical mud properties of a gypsum base mud in the Tioga area of North Dakota.

2. Lime base muds. (Figure 3B.) Lime base muds have been used extensively in the southern and eastern rim of the Williston Basin, but have proven to be more expensive than gypsum muds for the Tioga, Wolf Point, and Glendive areas. This system is a lime-saturated mud which will tolerate gypsum and anhydrite drilled. Salt can be drilled with lime muds, with the mud properties being controlled by an addition of salt water clay and starch.

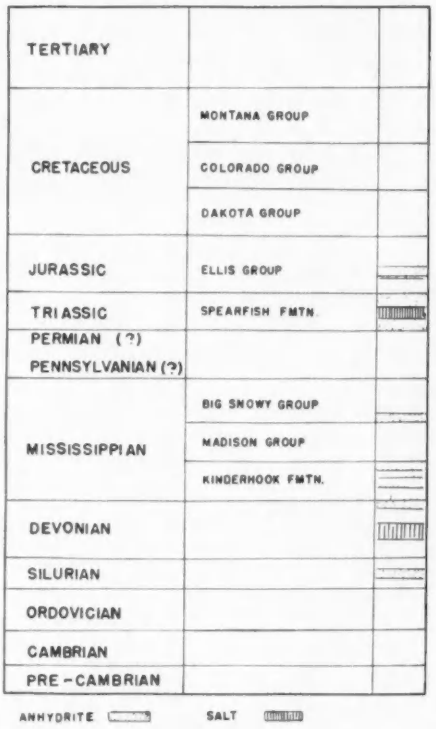


Fig. 2—Formations and contaminants.

The "top-hole" mud is converted to lime at a short distance above the Triassic Spearfish formation. The mud becomes quite viscous during the conversion of the bentonitic particles from a sodium bentonite to a calcium bentonite. The resistivity of lime muds is quite low, and in the range of from 0.8 to 1.5 ohms per meter squared meter. Lime base muds are of two general types:

• **Caustic soda-tannin-lime muds.** The procedure for this conversion is to add 3 to 5 pounds per barrel of hydrated lime to the light chemically-treated native mud. At the same time the lime addition is made, it is necessary to add from 20 to 40 percent by volume water to control the solids content and the viscosity. One pound per barrel of caustic soda and 1 to 1¼ pounds per barrel of tannin is added to assist the conversion to lime.

The mud system may become quite viscous during the lime addition. After this base exchange operation is completed and the funnel viscosity is in the range of from 40 to 50 seconds per quart, the addition of ½ pound per barrel of sodium carboxymethyl cellulose and 5 pounds per barrel of pre-gelatinized starch is made through the mud hopper to obtain a filter loss of from 5 to 6 cc per 30-minute API test.

The viscosity is maintained at 40 to 50 seconds per quart with bentonite or salt water clay. The filtrate loss is controlled with starch. The cost of the conversion is approximately $2 per barrel of mud, and the daily maintenance costs will vary with the mud weight buildup.

• **Calcium ligno sulfonate-lime muds.** The procedure for this conversion is to add 2½ to 3½ pounds per barrel of calcium ligno sulfonate and from 4 to 5 pounds per barrels of hydrated lime to the native mud system. Twenty to 40 percent by volume water is added to permit the base exchange operation to go to completion. One-half pound per barrel of sodium carboxymethyl cellulose and 5 pounds per barrel of starch is added to obtain a 5 to 6 cc API filter loss. The cost of the conversion is approximately $2 per barrel of mud. Crude oil or diesel oil can be emulsified in this type of lime mud, due to the presence of the calcium ligno sulfonate.

3. High pH red muds. High pH red muds have been used in the Poplar and Glendive areas of Montana and along the southeast perimeter of the basin. This mud system will tolerate the gypsum or anhydrite drilled, with the mud properties being controlled by the addition of chemicals and water. The pH of the top hole mud is raised to 12.3 just prior to drilling into the first anhydrite zone with equal parts of caustic soda and tannin. When anhydrite is drilled, it has been the procedure to add two parts caustic soda and one part tannin to control the viscosity and gel strengths.

Sufficient sodium carboxymethyl cellulose is added to control the filter loss. Some water dilution is necessary while drilling massive anhydrite sections. It is necessary to add starch to control the filter loss characteristics in the event salt is encountered and the salt concentration of the mud exceeds 4 percent. The total cost of this type of program is approximately 25 percent less than the total cost of a gypsum base mud if the salt concentration remains less than 4 percent. Maintenance costs are dependent upon the amount of anhydrite and/or salt drilled.

4. Barium carbonate muds. It is realized that barium carbonate could

be used to chemically remove the anhydrite as it is being drilled. It is felt, however, that due to the large amount of anhydrite present to be drilled in the Williston Basin that this type of program would be economically unfeasible. Due to the areal extent and amount of salt which is present in the basin, the use of barium carbonate would be prohibitive.

5. Saturated salt muds. Some operators have decided to use a saturated salt-starch mud system for drilling through the massive salt zones. These operators have noted a number of production casing string failures; where the casing has collapsed at or near the top of the massive salt zone. In the past, the practice has been to drill these wells with a conventional gupsum mud. A hold caliper has shown a large washed out zone at the top of the salt section in such wells.

It is believed that the casing failures have resulted from a formation collapse into this void and against the casing string, or a combination of such a formation collapse against a casing string which has been weakened by corrosion. An attempt is being made at this time to recover a section of this collapsed casing string.

Sodium chloride is being added to the mud system at or near the top of the Triassic Spearfish formation, until a concentration of at least 270,000 parts per million of sodium chloride is present in the system. The filtrate properties are controlled by starch additions. Saturated salt water is used as a make-up water for subsequent water additions to the mud system.

This type of system will have a density or mud weight of from 10.8 to 11.2 pounds per gallon, which could cause additional loss of circulation in the Tioga-Beaver Lodge area and the Glendive area. Crude oil is being used to decrease this mud weight to less than 10.7 pounds per gallon. Approximately 18 percent by volume of crude oil is maintained in the system at all times.

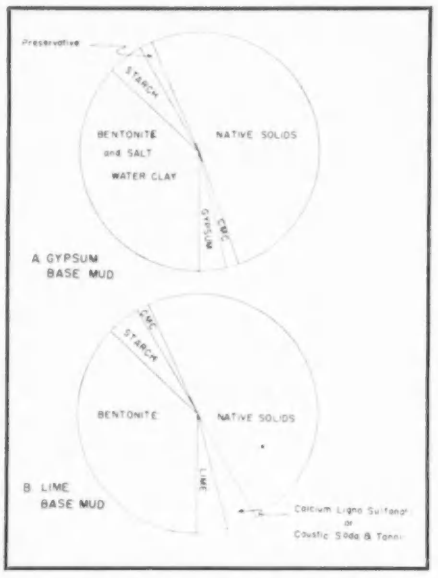


Fig. 3—Composition of mud systems. (Aqueous phase not included.)

Emulsifiers are used to emulsify this oil into the gypsum-salt mud. Calcium ligno sulfonate or liquid chemical emulsifiers are used for this purpose, with two pounds per barrel of the calcium ligno sulfonate being used or 1 percent by volume of the liquid emulsifier being used. Wetting agents or defoamers are used to prevent excessive foaming of this mud system. The cost of this type of system is from $2000 to $2500 more than the cost of a conventional gpysum mud in the same area.

The writer is of the opinion that greater consideration will be given to the following items in planning and maintaining good drilling mud practices for the Williston Basin in the near future.

- Improvement of the present type of gypsum base muds by the addition of suitable dispersive chemicals. Most drilling mud service organizations are performing extensive laboratory work in this respect at the present time.
- Expanded usage of high pH muds and lime muds in areas of low salt concentrations. Laboratory work and field trial tests have been made to permit greater use of this type of program in all areas of the basin.
- Reduced total drilling mud costs will be reflected as knowledge of drilling conditions and drilling problems become more apparent.
- Use of diesel oil or crude oil in mud systems where complete oil emulsification can be obtained and where no salt water clays are being used.
- Use of corrosion inhibitors in drilling muds to prevent the corrosion of drill strings. Sodium dichromate or sodium nitrite could be used for this purpose at an approximate cost of $300 per drilling well.
- Use of protective corrosion inhibitors behind production casing strings opposite salt zones to prevent casing failures in completed wells due to salt corrosion and bacteria attack.

It is felt that improved drilling mud practices can be developed for this area of operation by the continued close cooperation of oil operators, drilling contractors, and drilling mud service organizations.

—The End

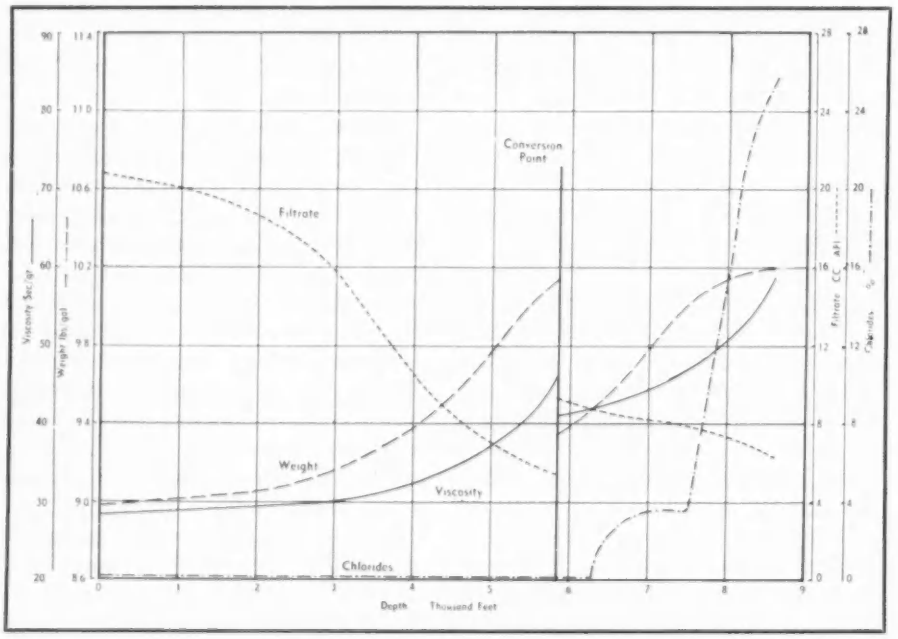
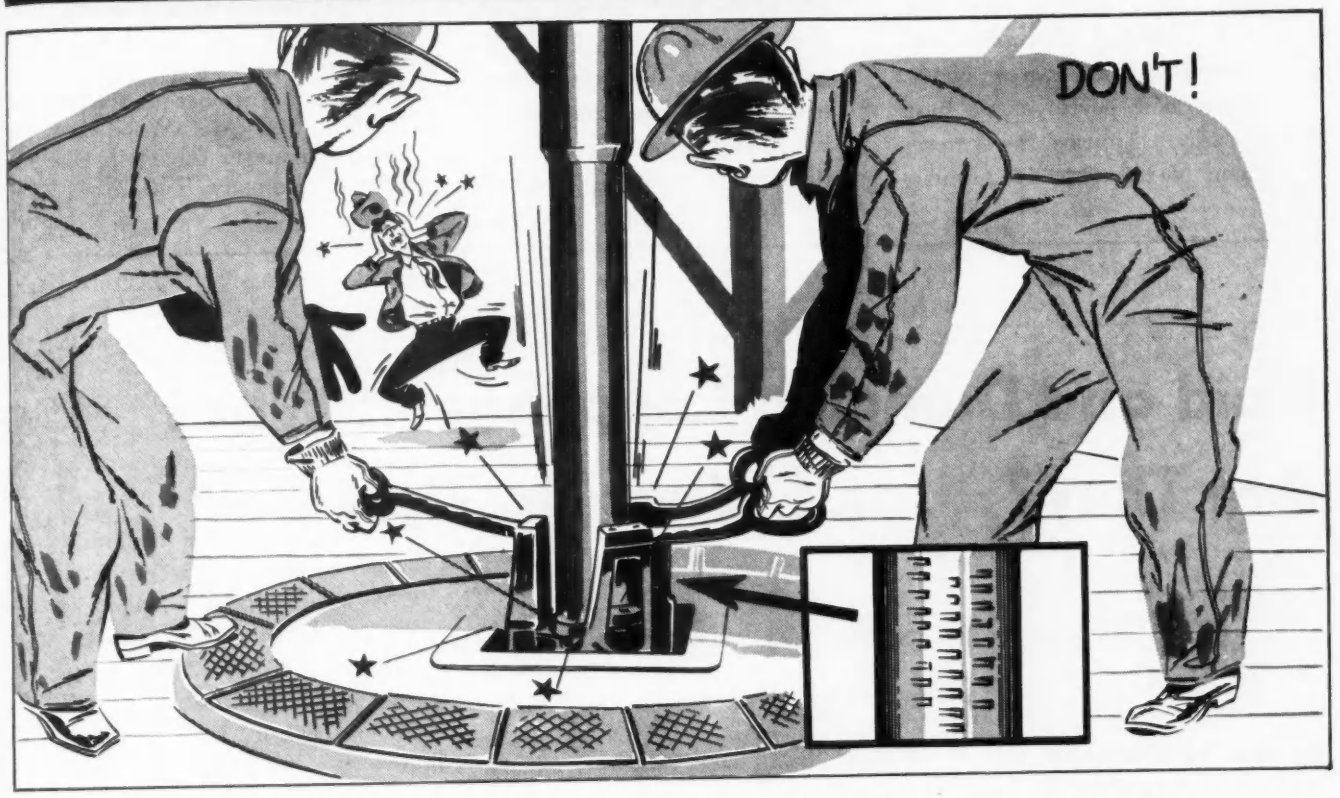


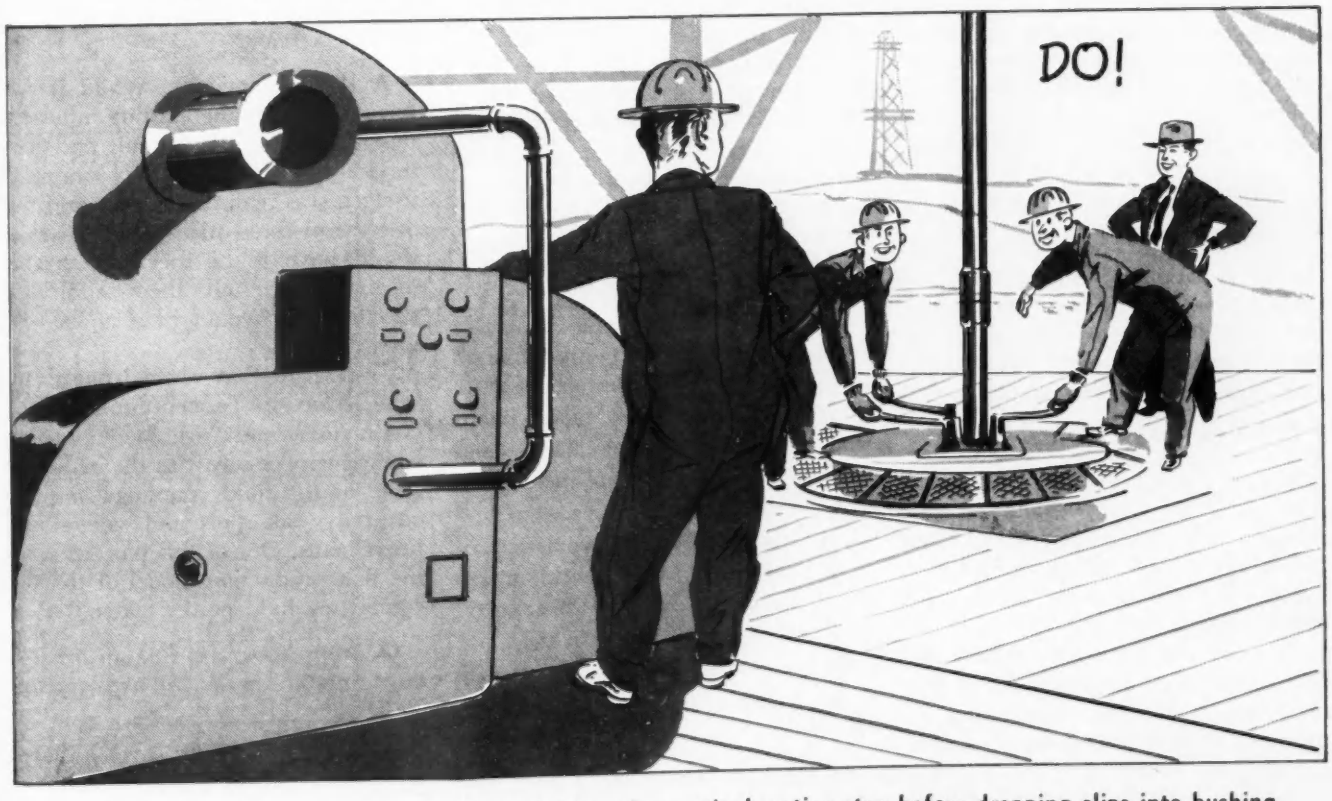
FIGURE 4

World Oil Graphics

Drill Pipe Care



Stopping pipe travel with slips damages drill pipe. Scar on pipe results in stresses and corrosion.



Avoid cutting of pipe by dogs on slips by letting pipe vertical motion stop before dropping slips into bushing.

a WORLD OIL interview

Drilling contractors have always been greatly concerned with reducing downtime and cutting maintenance costs. Many new developments have contributed toward the achievement of this objective. Among the more recent is the introduction of the fluid coupling which is designed to absorb shock. As every drilling contractor, engineer, and rig man knows, shock is one of the primary causes of rig damage resulting in downtime. Certain points not generally understood by the average drilling man are set forth in the following interview by WORLD OIL staff member Anthony Gibbon with Mel Woodward, district manager for Twin Disc Clutch Company, Tulsa.

Fluid and Dumping Couplings . . . What Are They? . . . and What Do They Do?

We asked an expert and here are his answers.

By MEL WOODWARD, District Manager, Twin Disc Clutch Company, Tulsa
and ANTHONY GIBBON, World Oil Staff

Q *There has been a lot of talk in the oil patch lately, mostly from drilling contractors, about dumping couplings and fluid couplings. Some contractors just say outright that they wouldn't have a rig without them. What are fluid couplings and dumping couplings? What do they do?*

A First off, let's discriminate. The dumping coupling is simply a fluid coupling with provisions for cooling the fluid and for exhausting all the fluid from the coupling in order to give it a positive disconnect.

Q *Why are those features necessary?*

A Let me fill in the background there a little. You've followed this business. You know that the drilling industry is always looking for improvements—better techniques, better tools, better service.

Oil field people recognized long ago that the drilling rig presented a real need for cushioning, cushioning to prevent the snap stretching of chains, to ease the engagement of clutches, to reduce the side loading of bearings, to inhibit the torsional fatigue on shafting and to extend engine life. The fluid coupling was designed to offer just that sort of cushioning, but it needed additional features over the standard industrial type to permit good installation in rigs. It also needed to be designed "oilfield" for oil field service. And it was recognized that it could be designed to provide substantial performance benefits.

Drilling contractors and rig manufacturers liked the cushioning characteristics of the fluid coupling, but laid down the traditional requirements that such a unit must be simple and serviceable, should be inexpensive of installation both in the rig shop and in the field, should be compact, of long life, easily operated and understood, sturdy enough to withstand oil field moving, and because of the space consideration it should act not only as a cushion but also as a cut-off clutch.

Q *Do you mean that it took this many additional features to make a standard industrial unit acceptable for oil field service?*

A Well, practically. While it was recognized that the existing industrial type fluid coupling certainly had good service life and was pretty simple of itself, it was realized that the addition of some of these other special features would have to be met and that in meeting them all these additional specifications would have to be met also.

Getting all that worked out was a real lesson in cooperation. Drilling contractors and rig manufacturers worked very closely with the manufacturer of the fluid couplings to point out the weak spots and suggest improvements. Out of this pattern came the first production model of the disconnecting fluid power take-off.

Q *From the talk I've heard this must be well beyond the experimental class?*

A Yes, in about three years more than two hundred dumping couplings in the 150 to 300 horsepower class

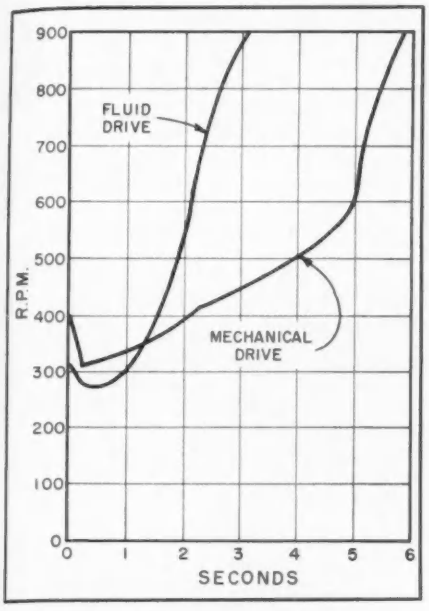


Fig. 1—Engine compound speeds.

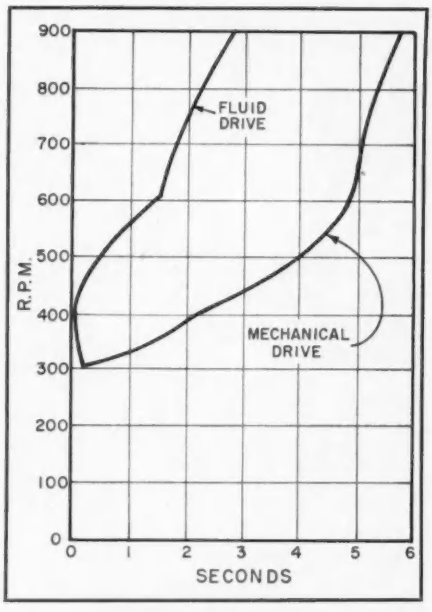


Fig. 2—Engine speeds.

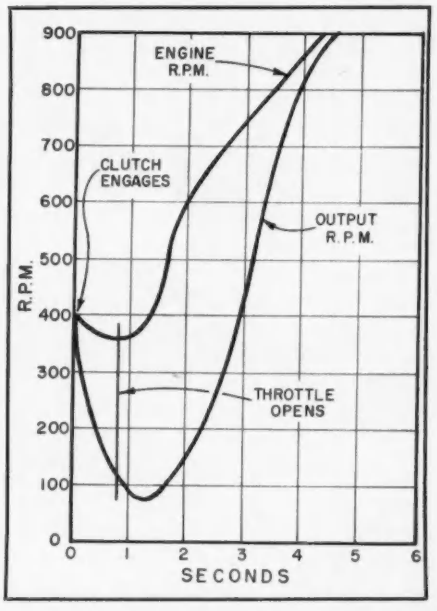


Fig. 3—Engine rpm vs. fluid coupling output rpm.

were installed in drilling rigs alone. The majority of these were purchased by operators who installed them in more than one rig, after having observed the effect on their first rigs.

Q *These pictures you have here, one of them shows a tall unit and the other a short round one. What about that?*

A Yes, you're right there. The picture in Figure 7 shows a slightly older style unit which depended upon the engine for its cooling. The fluid was cooled either through a radiator installed in front of the engine radiator or through a heat exchanger on the engine cooling system.

The picture in Figure 6 illustrates the typical modern disconnecting fluid coupling. This unit was first shown at the Oil Show last year. It is a completely independent unit. You will notice in the upper part of the cutaway the radiator and the fan and then within the housing near the top is the pump and filter and valve.

Actually, the change that you notice between Figure 6 and Figure 7 was the only major improvement suggested by drilling contractors and other rig operators after a couple of years of service.

Q *Then it met the oil field specifications pretty well?*

A It was practically designed by oil field people. Look at that Figure 6. There are only two moving parts in it besides the pump and fan, and you can see that the filter and the fan, the pump and valve are all accessible from outside.

Q *Can they be installed only on new rigs?*

A No, the unit simply bolts to the flywheel housing and connects to the driven shaft at the output end. About a hundred of them have been installed on older, operating rigs. The engine position is altered hardly at all when this unit replaces a conventional friction power take-off because the distance from the engine flywheel housing to the output shaft is substantially the same.

Q *What is the life between overhauls?*

A We don't know yet. The oldest units have been out only about four

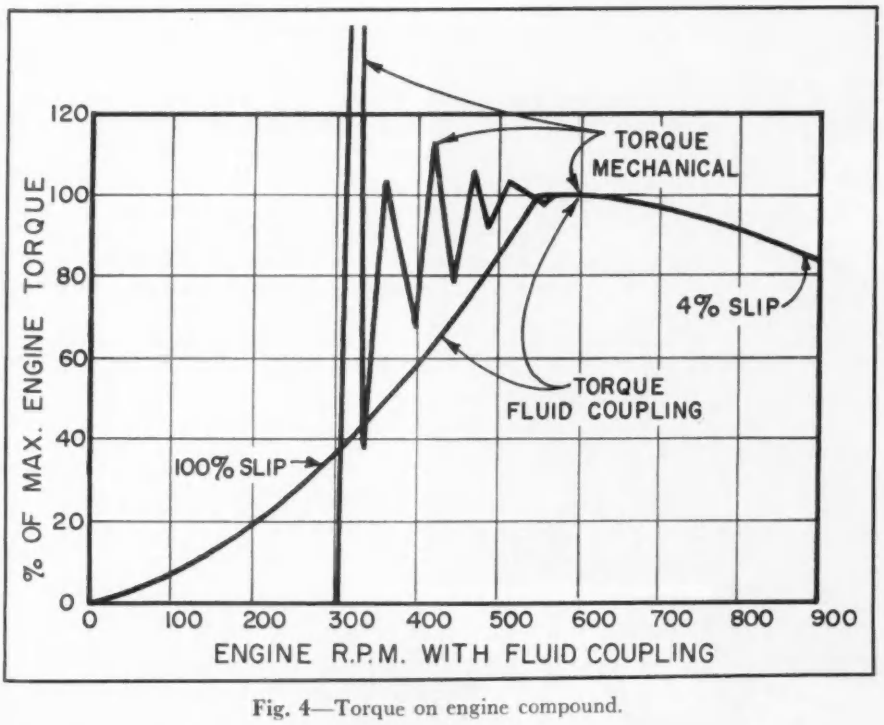
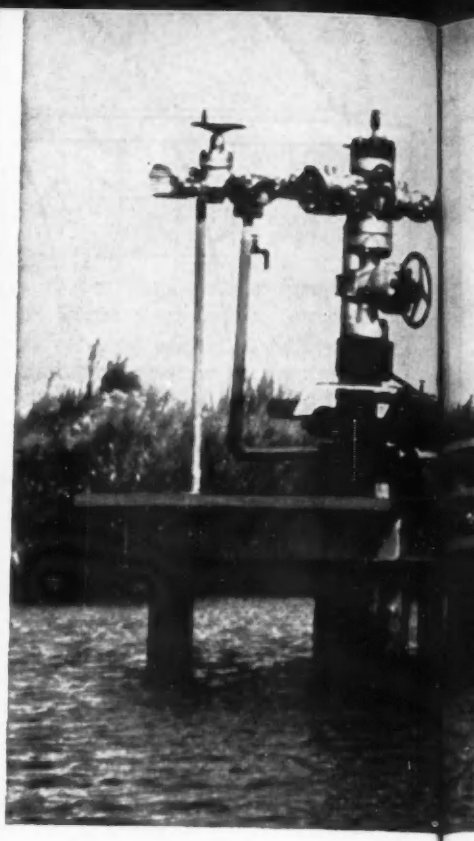


Fig. 4—Torque on engine compound.

In one of the world's deepest producing wells...



Gonsoulin-Minvielle State Unit No. 2. On completion, the well flowed at a daily rate of 141 barrels of 42.5 gravity condensate and 4,293,000 cubic feet of gas through a 24-64-inch choke. Eight of the world's 10 deepest producing oil wells are at Weeks Island.

Roustabout Gang setting up test equipment for the well. The equipment was all connected up on a barge and moved to the well ready for operation.

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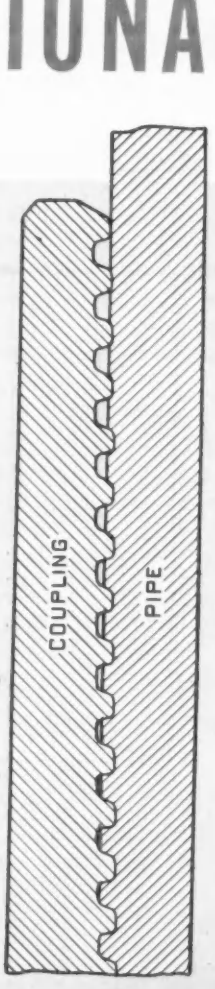
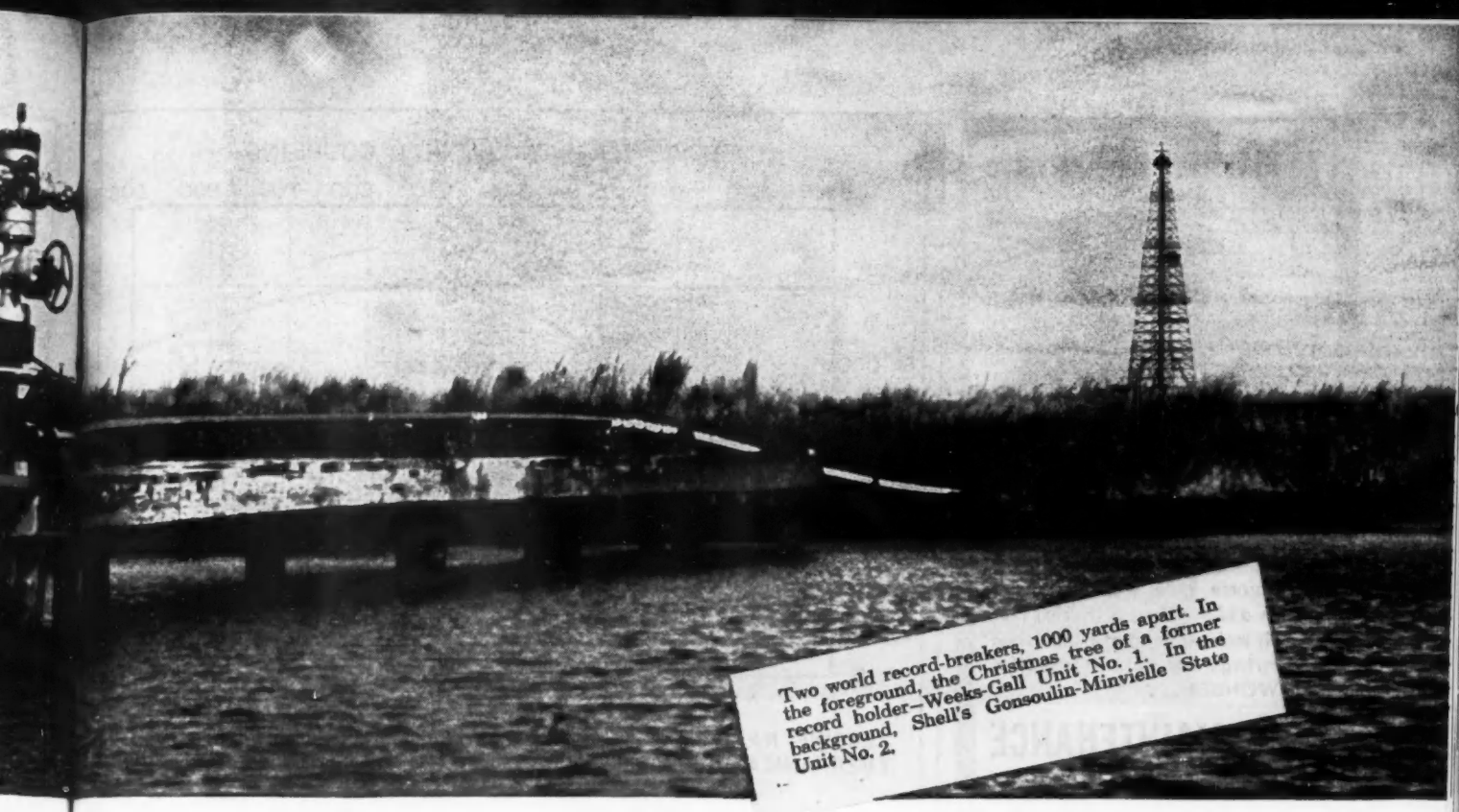


BUTTRESS THREADS AND COUPLINGS



Two world record-breakers, 1000 yards apart. In the foreground, the Christmas tree of a former record holder—Weeks-Gall Unit No. 1. In the background, Shell's Gonsoulin-Minvielle State Unit No. 2.

s. of casing were supported by BUTTRESS-THREAD CASING

In drilling the Gonsoulin-Minvielle State Unit No. 2, at Weeks Island Field, 15 miles south of New Iberia, Louisiana, Shell Oil Company has accomplished feats believed unprecedented in the oil industry. Among them:

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For further information on National Tube developments in the oil industry, write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa.

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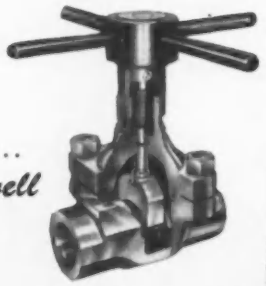

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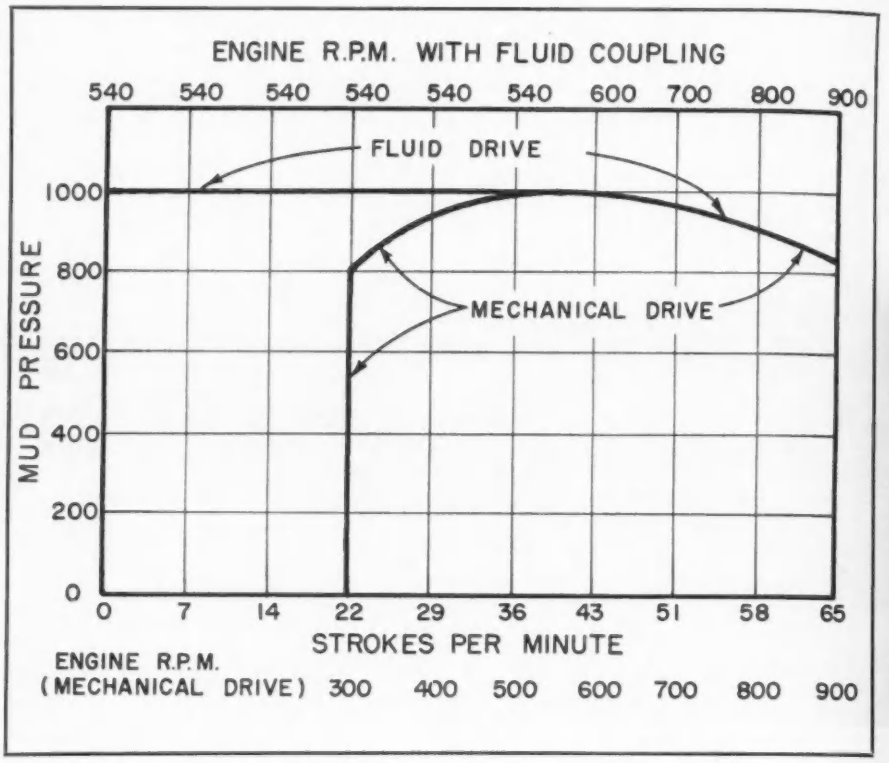

Fig. 5— Mud pump performance.

years now and they haven't required any attention yet, except for the elimination of a few service bugs, so we think the period between overhauls will be completely acceptable to the average operator.

Q *Let's go back a little bit. You have only shown what the unit is. Now how does it operate?*

A Let me try to describe it this way. In the operation of the fluid coupling the impeller drives the fluid in an orbit about the shaft. The rotational velocity of the fluid about the shaft creates a centrifugal moment in the fluid which causes it to seek escape away from the shaft. Upon escape from the impeller at its outer diameter the fluid is directed into the runner. Upon striking the runner blade the fluid imparts to the runner most of its kinetic energy. This tends to cause rotation of the runner. Upon surrendering some of its kinetic energy, the fluid then has less rotational velocity, consequently less desire to escape from center.

It is, therefore, pushed back toward the center by the fluid which follows it escaping from the impeller. Thus, the fluid which has surrendered its

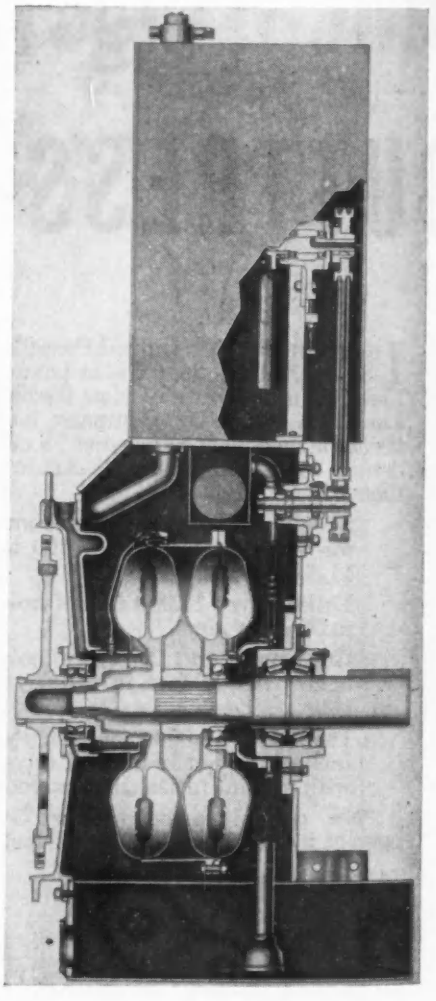

Fig. 6—A late design fluid coupling.

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How is shock reduction achieved?

energy to the runner is pushed back toward the shaft and into the impeller for recirculation.

Q *Then the fluid circuit would be fairly illustrated by a coil spring with its ends together—like a doughnut?*

A Exactly. Now, the capacity of the fluid coupling is a function of the rate of flow of the fluid mass. If the speed of the impeller and the runner were equal, it can be seen that no power can be transmitted. This is because the rotational velocity of the fluid is equal in each of those elements. With equal rotational velocity the desire of the fluid to escape from center is equal in each element. Therefore, no circulation can result. Since capacity is a function of circulation no power can be transmitted.

Q *Then it has to slip to transmit power?*

A Yes.

Q *When it slips does it multiply torque?*

A No. In the fluid coupling there is no intermediate or fixed reactor blading. Because an old physics law states that each action shall have an equal and opposite reaction, the torque of the impeller is equal to the torque of the runner.

Q *You said the main function of the fluid coupling is to reduce shock. How is that achieved?*

A In an excellent article published in the December issue of WORLD OIL, M. L. Rizzone particularly emphasized that the hydraulic drive dissipates the shock loads over a much longer period of time and with generally less than one-third the drive stress created by the engagement of a friction drive. That, of course, is a logical result of the coupling formula: capacity is a function of the rate of flow of the fluid mass. The high stresses which damage all the operating parts of a straight mechanical rig are a result of inertia.

The fluid coupling plays the inertia of the fluid within the coupling against the inertia of the rig. Since a high rate of flow of the fluid mass is required for high capacity in the coupling, it follows that in order to create that high capacity the fluid flow must be speeded up. Just as the machinery in the rig is reluctant to get moving, so is the fluid in the coupling.

Q *So it is actually the inertia of the fluid within the coupling which provides the protective cushion that so greatly reduces damage to the rig?*

A Yes. That it actually does so is proved by improved chain life, because clutches do not wear out or require frequent adjustment, because bearings and shafts do not fail even at depths far beyond those at which the rig is rated, and because engine life is increased too.

Q *Earlier you spoke of a possible performance bonus which properly applied couplings could be expected to provide.*

A The curves in Figure 1 were taken from an actual rig with couplings and from a comparable rig with only the straight mechanical drive. Both rigs were identically powered. Both were hoisting an 8000 foot string of 4½" drill pipe with six drill collars. It will be seen that the rig with the fluid couplings accelerated its load of pipe more rapidly than the other.

Now notice the area in which the more rapid acceleration did occur—between 300 and 600 r.p.m. Above 600 r.p.m. the rate of acceleration was approximately equal in each of the rigs.

Q *Why did the faster acceleration take place mainly below 600 r.p.m.?*

A Because at low r.p.m. the coupling transmits little power; it leaves the engine virtually unloaded. Look at Figure 3. The peak torque point of these engines falls at about 600 r.p.m. With the output shaft of the coupling completely stalled, the engine at full throttle will pull down only to about 600 r.p.m. So the engines rapidly accelerate to about 600 r.p.m., which is their peak torque point.

This occurs in about two seconds, whereas the engines of the straight mechanical rig are lugged down way below their peak torque point and therefore accelerate only very slowly. The rapid acceleration of the rig is one part of the performance bonus that the coupling offers.

Q *Looking at Figure 3, there, the clutch is engaged before the throttle is*

opened, and it still does not kill the engine. That is what you meant by saying the couplings virtually unload the engines?

A Yes. The curves in Figure 1 were both made using the same sort of coordination between throttle and clutch. In Figure 3, however, the clutches were dropped in at zero seconds, whereas the throttles were not opened until almost one second later. This caused a drop in compound speed to below 100 r.p.m., but created only a small drop in engine r.p.m. Yet, as Figure 1 shows, the compound still came up to speed more quickly than on the straight mechanical drive.

Q *In Figure 2 the engine is pulled down 100 r.p.m. in only ¼ second on the mechanical drive. Is that what is hard on the engine?*

A Yes, that's one of the things that are tough on engines. Besides that, all other load shocks are transmitted directly to the engine in the straight mechanical drive. The fluid coupling protects the engine against them all.

Figure 4 is a typical example of comparison between inertia working for us and inertia working against us. In case of the straight mechanical drive we certainly have inertia working aganist us. The rotating inertia of the engine meets with the static inertia of the drawworks and pipe with no extended time area in which to settle their differences. On the other hand, in the fluid coupling rig the inertia of the fluid within the coupling provides the time element which permits the torque rise to take place smoothly.

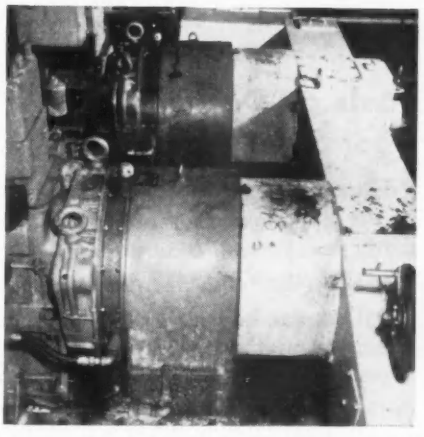

Fig. 7—Simple installation of older model. Beneath the guard between fluid coupling and chain compound is rubber block drive output. This permits easy engine-coupling placement and removal when moving the rig.

Q *Well, that's clear enough. What's the story on this Figure 5?*

A Here is another part of our bonus. Figure 5 shows mud pump pressure vs. strokes per minute with the fluid coupling drive as against the mechanical drive. Engine r.p.m. in the mechanical drive is listed at the bottom of the curve. Notice that it is impossible to operate the engine at speeds below 300 r.p.m. Even at 300 r.p.m. the torque of the engine and therefore the mud pressure has dropped off considerably. The engine r.p.m. with the fluid coupling drive is listed at the top of the curve.

Notice that the engine never drops below 540 r.p.m. even at zero strokes per minute. Because the engine stays at its peak torque point even down to zero strokes per minute the mud pump pressure can be maintained at its very maximum all the way to zero strokes per minute. This could be very important in the face of a blowout threat —another part of the bonus.

Q *How long could you maintain full throttle at zero strokes?*

A Three or five minutes without risking damage. Much longer if the emergency justified the risk of making the seals brittle. Figure 5 could equally well be used to illustrate how the addition of the fluid couplings make any rig a bigger rig. It is apparent that a long string of pipe which required very nearly the maximum engine torque would be impossible to hoist in a straight mechanical drive rig without burning up the clutch, for the engines would stall before overcoming the static inertia of the pipe. The introduction of the fluid coupling to the rig provides the time element necessary to overcome the static inertia of the pipe in the hole while the engine continues to pull at its peak torque point.

The ability of the coupling to provide cushioning is exactly the same feature that permits the rig to do a faster, bigger job. In both cases it comes back to what was said before—the introduction of the time element which is brought about by the inertia of the fluid within the coupling.

—The End

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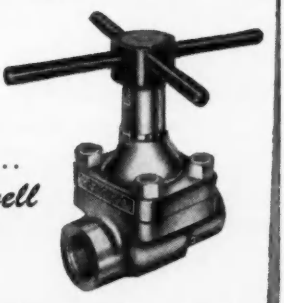

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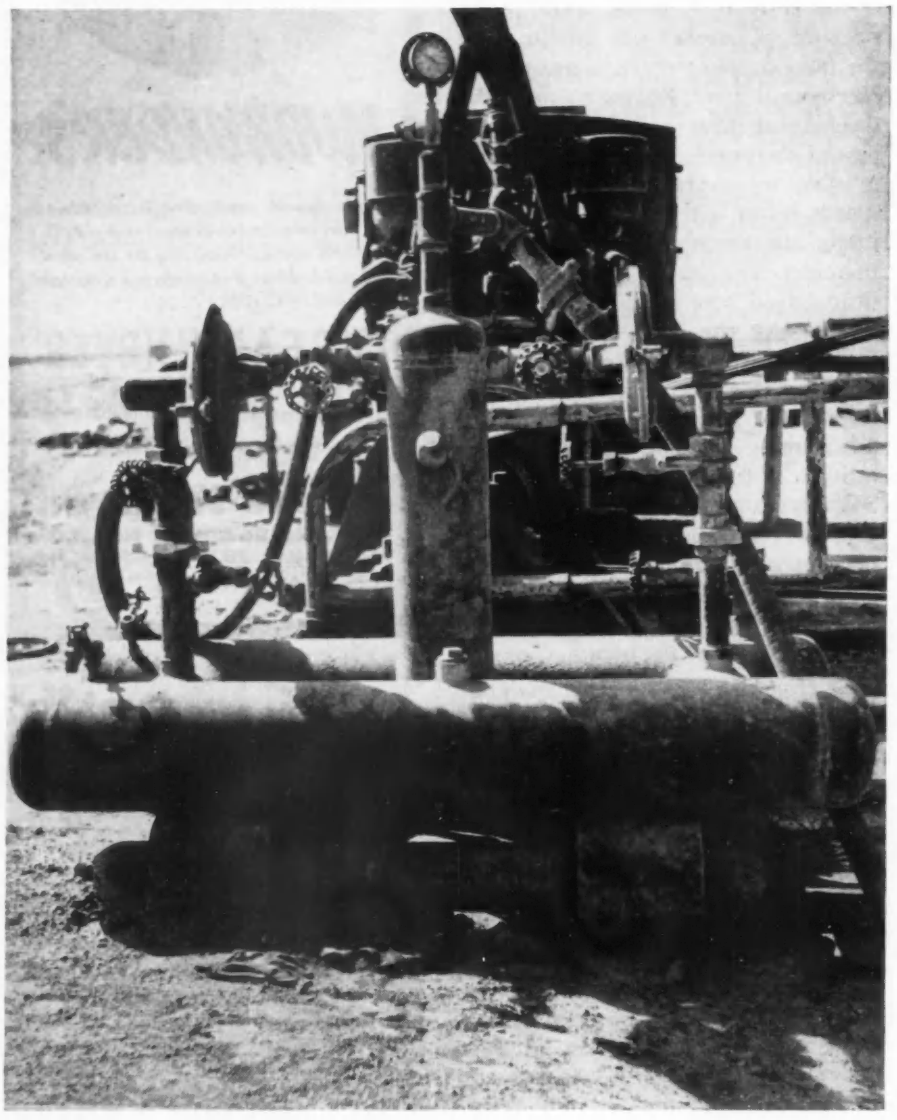
How to do it
DRILLING HINTS

$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas.



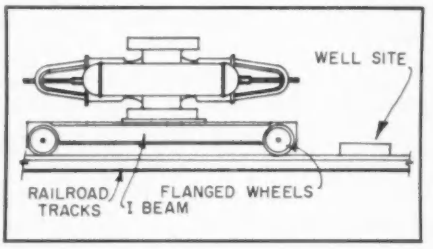
Volume Chamber Will Stop Surges

Make a volume chamber for the fuel gas supply to an oil field drilling pump which will adequately keep surges from the fuel system and remove condensate from the gas as it is successively stepped down in pressure. The gas supply feeds into the upright bottle shown in the photograph. From this first bottle it passes through twin regulators located on either side and on into the surge bottle made of twin links of ten-inch pipe. These two pieces of pipe are capped at the ends with weld caps and tied together by two pieces of eight-inch pipe.

A piece of half-inch pipe is run to the bottom of each of the ten-inch sections so that a small valve can be opened and liquids blown from the chambers. Fuel gas is piped to the engine through a rubber hose shown at the left. The entire assembly is welded to the skids on which the pump is mounted.

Wellhead Equipment Transported on Track

The Brewster-Bartle & Company of Corpus Christi has devised a short railroad track which straddles the keyway slot of the drilling barge allowing the heavy blowout preventer equipment to be rolled into place at the well site. Railroad tracks 20 or 25 feet long are laid parallel with the slot. Flanged wheels straddle the track and are held together with a common steel axle. Extremely heavy I beams serve as the framework for the supporting members for braces on which the heavy blowout equipment rides. When the preventers are not in use, they are loaded onto the track by means of chain hoist.



During moves the wellhead equipment is moved out of the way and is chained to the wall so that the rolling sea will not cause the heavy equipment to move about uncontrolled.

Tools on Doghouse Door Safe, Handy

Hanging hand tools on the inside of the doghouse door offers two advantages:

- They are conveniently located.
- They can be kept locked up when not in use.

When the toolhouse door is open, the tools are racked within two or three steps of the driller's station and each tool is easily identified.

Two rows of welding rod material welded together form hooks to hold the larger items. The oil can and

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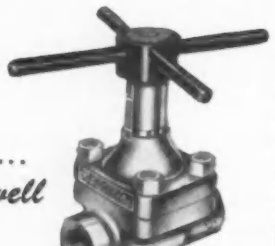

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HINTS . . .

grease gun are hung on the top row for convenience. Wrenches and the hacksaw are hung on the second row.

A steel strap is welded to the inside of the door forming loops to hold such tools as hammers. A pocket is made on the lower part of the door to hold tools such as the screwdriver, tape lines, and smaller tools.

Once the tools are in their proper places, workmen are notified where each tool belongs and the driller can keep close check on the tools by merely glancing at the door from his station.

He can see what tools are missing at the end of a tour and have the missing tools returned. This arrangement also helps keep tools cleaner. Workers are more likely to wipe the tools before hanging them in such a conspicuous place.

How They're Saving Catline in Sumatra

In Sumatra one driller has spliced catline rope to an old swab cable and has effected a saving of 75 percent on expensive rope.

Usually the catline consists of only rope, but by using 200 feet of $\frac{5}{8}$-inch steel cable and splicing it to 100 feet of $1\frac{1}{4}$-inch manila rope, substantial savings can be realized.

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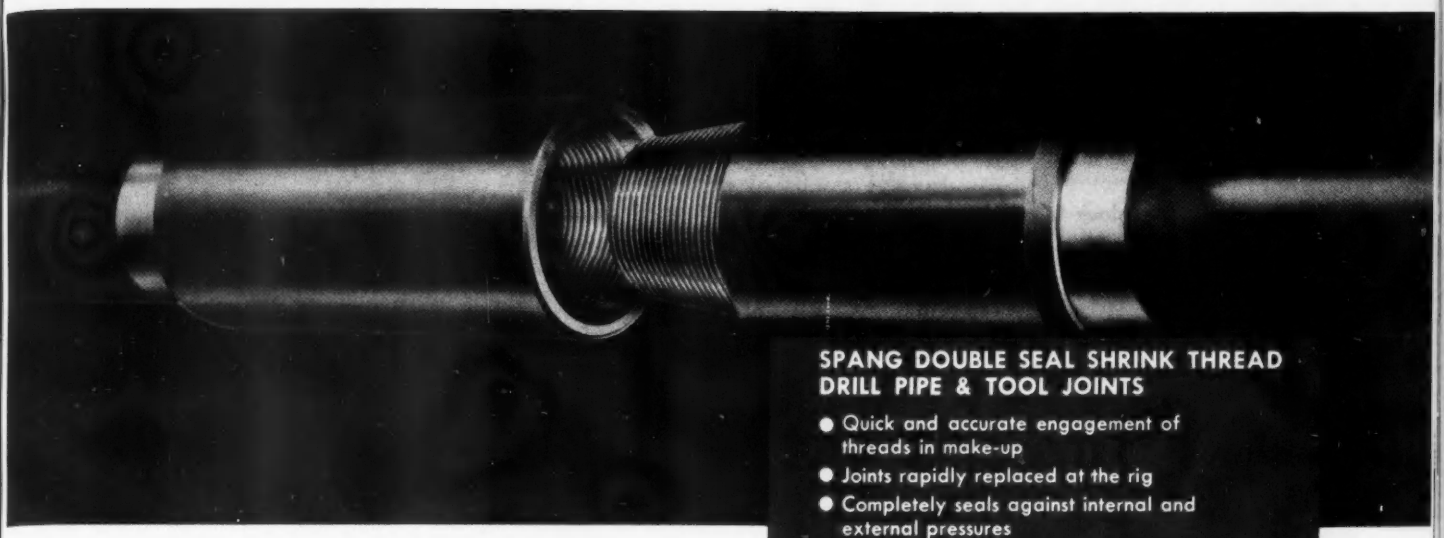

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Precision metal-to-metal seals in the Spang Double Seal Shrink Thread tool joint eliminate leakage and washout, prevent fluid entry into threads and provide high resistance to creepage. Whenever necessary, Spang Double Seal Shrink Thread tool joints can be rapidly replaced at the rig.

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Come-Along Chain Replaces Turnbuckles

An ordinary "come-along" chain hoist is being used by some contractors to replace the screw-type turnbuckles to adjust guy wires on rigs. The chain hoist is kept with the guy wire when the rig is enroute. When the stakes are driven, it is a simple matter to wrap the chain around the stake and take up the slack with the hoist.

When the crown block is not over the well and the slips are hard to set, it is easy for the driller to send two men to the opposite guy wire stakes with one letting the slack out and the other taking it up until the rig is adjusted.

Where the guy wires are on the front of the unit as shown, they are loosely adjusted until there are several stands of pipe in the rig, then they are tightened up to keep the rig from drifting back toward the hole.

When it is time to tear down, the chains can be slipped up on the stakes and the stakes pulled out with the chain hoists after they have been slightly loosened with a sledge hammer and driven toward the rig. This stake pulling process would be very time consuming using turnbuckles.

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Sheet Metal Cover Protects Mud Tank

Many times to conserve space, mud tanks are placed below the rig floor. This presents the problem of how to keep water and extraneous objects off the rig floor from falling in the mud tank.

A cover built of sheet metal roofing hung beneath the rig floor will serve this purpose very well.

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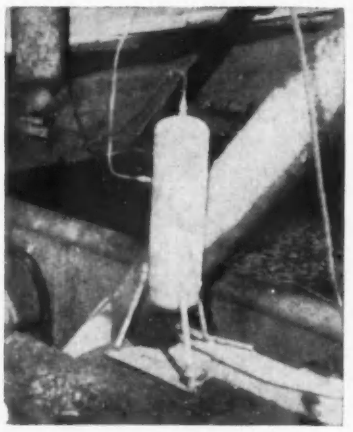
Truck Loaded To Meet Length Limit

Load the blowout preventers on the front of the float and place the kellys on wooden blocks resting on top of the preventers to keep the kelly within the length limits on highways. This loading procedure permits the kelly to stick out over the top of the truck cab rather than the rear.

The truck is spotted in a convenient place near the rig and disconnected at the fifth wheel. The winch and gin poles are then used to load the pieces on the float with the preventers crossways on the front. The kelly joints and drill collars are then loaded on 4-by-4 blocks which have been placed across the preventers. The equipment is then chained securely and the truck backed under the float and ready to roll.



Gas Bottle Stand Eliminates Hazard

Cylindrical bottles of gas placed lengthwise around a rig pose a safety hazard. One Gulf Coast operator has made a stand to keep the cylinders upright.

This not only makes the bottles more conspicuous but keeps the lines from the bottles from being stepped on.

This simple stand is made by welding three 12-inch pieces of sucker rod to a triangular piece of quarter-inch sheet metal. The legs are then welded in place on the bottle.

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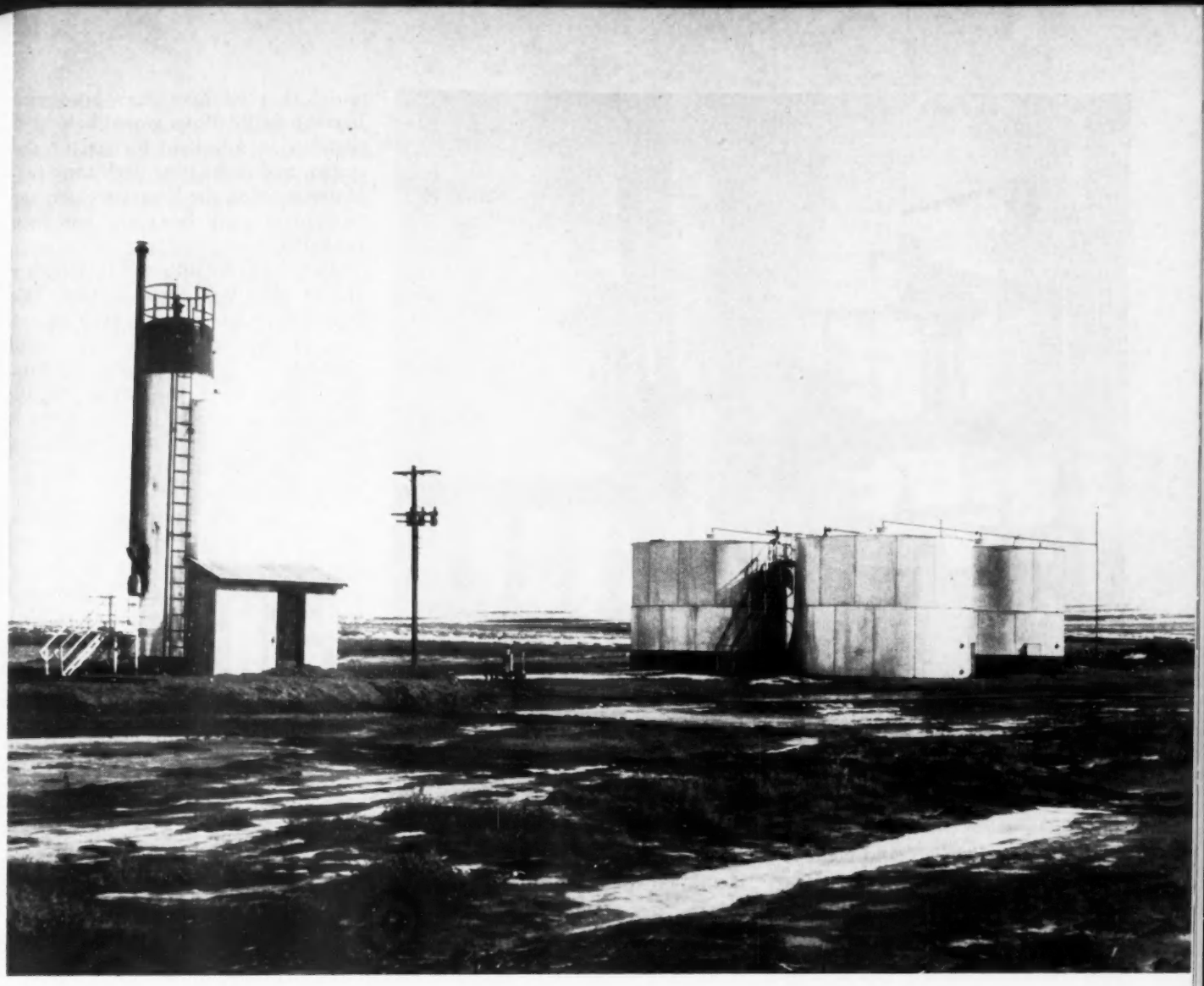


TYPICAL TANK BATTERY and heater-treater setup in the East Poplar Unit. Heater is insulated and all controls are housed in connecting shed.

Poplar Unit Operators Face Varied Production Problems

Paraffin, salt deposits, weather and floods plague operations in this prolific Williston Basin field just south of the Canadian border.

By J. HAROLD MILAM, The Murphy Corporation, Poplar, Mont.

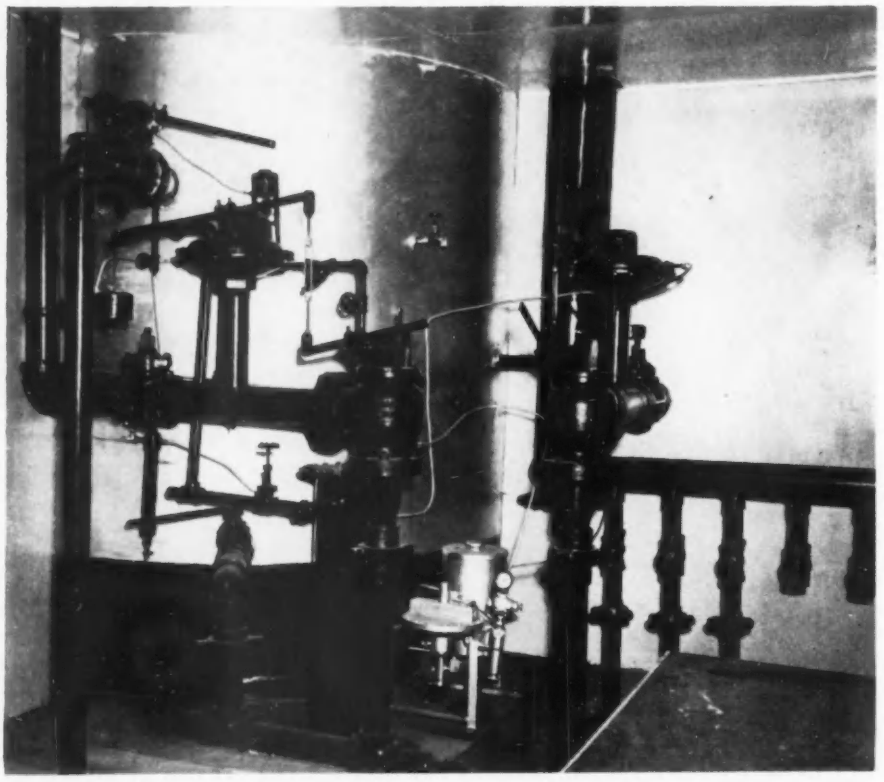
THERE ARE four major problems involved in the production of crude oil in the East Poplar Unit pool in the Montana sector of the Williston Basin area. These are:

- Paraffin accumulations.
- Severe cold weather.
- Salt deposits in the tubing.
- Surface mud caused by spring thaws.

The East Poplar Unit pool is located in the northeast corner of Roosevelt County, Montana, about 65 miles south of the Canadian border and some 55 miles west of the North Dakota line. It comprises approximately 35,000 acres and is owned jointly by The Murphy Corporation, Placid Oil Company, The Carter Oil Company, and Phillips Petroleum Company, with The Murphy Corporation as the operator.

The producing area lies in a general northwest-southeast trend, bisected by the Poplar River, a small tributary of the Missouri. Within the unit is a 160-acre tract with four producing wells not owned by the unit partners. Also at the extreme north side are two additional wells, direct offsets to the unit property but not owned by the unit partners.

At the present time, approximately 10,000 acres within the unit boundary have been proven to be productive by the drilling of 35 producers and one dry hole by the unit opera-



INTERIOR OF SHED which houses controls. Note that the flow line header is also located here along with the liquid level and temperature controls. Chemical injector also is placed here. Shed serves as the pumper's shack.

tor, and six producers and eight dry holes by other operators.

Production is from porosity zones of the Madison formation, Mississippian age, at an average depth of 5800 feet. Production rates are governed directly by market conditions rather than by the maximum efficient rate of production.

Tank battery hookups. Twelve tank batteries have been strategically located to handle present and proposed unit wells. A typical tank battery installation consists of two 1000-barrels galvanized cone-bottom steel tanks with an 8-foot by 27½-foot heater treater.

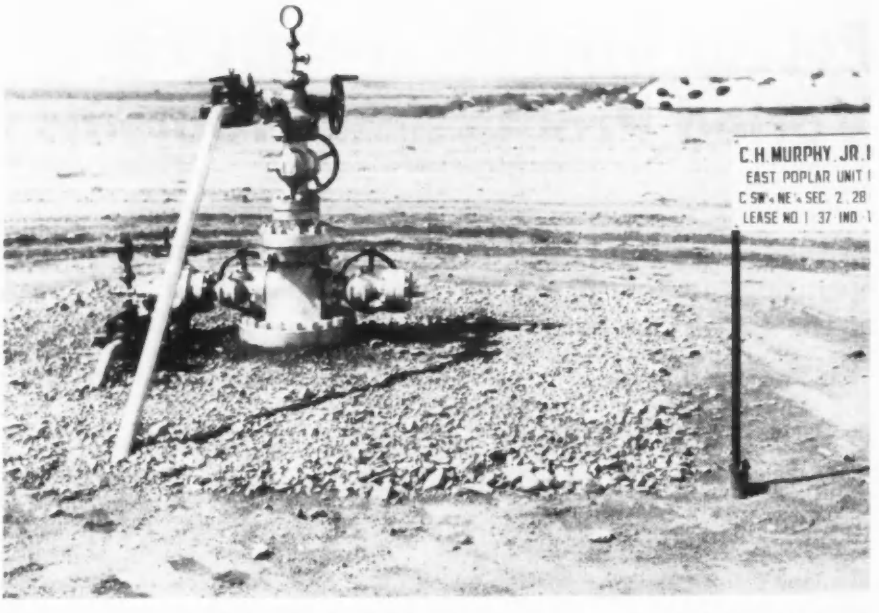
Treaters are insulated with a three-inch blanket of fiberglas covered with aluminum sheathing. All controls that operate the treater are grouped on one side and covered by a small, insulated building to prevent freezing. An electrically-driven rotary pump is located between the treater and the tanks so that oil may be circulated from the tanks through the heater treater to maintain temperature. The tank battery hookup is conventional with the exception that oil inlet lines go into the bottom rather than the top of the tanks.

Through trial and error it was found that in very cold weather condensation would freeze valves located on the top of the tank. It was also found that oil inlet lines positioned into the tank bottom would help keep paraffin in solution. By using this system and circulating each tank regularly through the heater treater, the buildup of tank bottoms has been negligible.

All valves on tanks and treaters are of the plug type with a relief hole drilled into the side of each so the core of the valve will drain when closed to avoid freezing and bursting. Vent lines from the tanks are installed in a vertical position since it was found that horizontally-installed vent lines collected moisture and became plugged with ice.

As wells make varied quantities of salt water, a small size water dump line has been laid from the heater treater to an earthen pit located about 150 feet distant. The water freezes in these lines during the severe cold weather where it is exposed to the atmosphere when entering the salt water pit. Fortunately, this condition exists only during short intervals of winter season.

Operating procedures. Bottom-hole temperature of wells in the Poplar Unit averages 246° F. Gas-oil ratio ranges from 10/1 to 150/1. Not sufficient gas is produced from the wells



TYPICAL WELL HOOKUP in East Poplar Unit, considered one of the best developed fields in the Williston Basin. All wells except one flow and must be pinched back to the 200-barrel-per-day allowable.

to maintain a desired temperature of 120° F. in the heater treater, but fortunately, a shallow zone in the north portion of the unit area is gas-bearing and two small gas wells have been drilled to supplement the gas supply.

Flow lines average 3500 feet in length and are buried below the frost line at approximately five feet in depth. With the help of the bottomhole temperature and a high rate of flow, it is possible to obtain oil at the heater treater, coming from the wells, at a temperature of approximately 80° F; however, this varies with the capacity of the wells and the length of the flow line. It is general practice to flow wells at a minimum rate of 200 barrels per day so as to maintain as high a temperature as possible. This practice also lessens the consumption of gas and deposits of paraffin in the tubing and flow lines. When market conditions are such that all wells within the unit cannot be operated at an economically efficient rate, general practice is to close wells in alternately rather than pinch down on the production.

Paraffin problems. The most difficult and constant problem encountered is the deposition of paraffin in the tubing and flow lines. This paraffin becomes extremely hard and frequently plugs flow lines completely unless a high rate of flow is maintained or weekly hot oil treatments are applied. Practically every leading brand of paraffin solvent and inhibitor has been tested in the field with negligible results. A few types have been found that would give a small amount of help if used in large quantities, but the large amount of chemical required makes their use economically prohibitive. Various types of soluble plugs and pipe line pigs have been tried but with limited success.

Use of a hot oil unit has been the most economical solution found to the paraffin problem. The procedure is to heat oil to from 160-180° F. and pump it through the flow lines until the heat is transferred throughout the length of the line, thus dissolving paraffin accumulation. This treatment must be given to the flow lines every 7 to 10 days on all of the weaker flowing wells. One well in the field that is pumping must be treated every five days to prevent plugging.

About the Author

J. HAROLD MILAM is a native of Smackover, Ark., and attended El Dorado Junior College. In 1936 he started work as a rig builder and later became a driller and then toolpusher for Cook Drilling Company. He joined his brother, R. L. Milam, as partner and formed the Milam Production Company. In 1950 he became Rocky Mountain district production superintendent for Murphy Corporation. Milam is a member of the IPAA; the Rocky Mountain Oil and Gas Association and is on the API Advisory Committee.

Weather problems. With the present system, production operations can be carried out almost as efficiently in the winter as in the summer. However, operational problems are created by extended periods of extreme low temperatures. It is during these periods that extra caution must be exercised to prevent exposure and frost bite among operating personnel. Common practice is to have two switches in two vehicles check the wells and tank batteries just as a precautionary move in case a man gets injured or has a vehicle failure. Snow and high winds can completely block the field roads in a very short time. Mobile telephones are used in most of the vehicles, not only for operating efficiency, but so that contact can be maintained with the field office in case blocked roads isolate an employe. Bulldozers and road graders are kept available on a standby basis throughout the winter season.

Surface mud. The most difficult time to maintain normal operations is during the spring thaw, which causes extremely soft conditions of the field roads. During this season, the East Poplar Unit is almost a sea of mud, and the Poplar River overflows, cutting the field in half and entirely isolating the north half of the field. As the days become warmer and the snow melts faster, the volume of water released is of flood proportion, and the river rises, releasing the ice that has been capped in it all winter. The ice breaks up and mammoth blocks damage all field bridges.

When this happens a heavy-duty truck is placed on the north side of the river and personnel transferred back and forth by boat, and sometimes by airplane, in order to keep operating. It is virtually impossible to keep flow lines from plugging during the spring thaw due to the inability to get hot oil units to the wells.

Salt Plugging. Three of the wells that are producing on the northwest flank of the unit area produce a varied amount of supersaturated salt water. When producing, the agitation and cooling of the water allows salt crystals to precipitate out of solution and tends to plug the tubing. This condition may be alleviated by periodic fresh water injections into the casing. Fortunately, of the three wells mentioned only one well is regarded as a chronic problem of this sort. The solution to the problem, however, is not nearly as simple as it sounds, as fresh water is extremely difficult to handle during the winter months. It is necessary that the amount of water produced must be diluted on a 50-50 basis with fresh water, which means, assuming a well produces 50 barrels of supersaturated water daily, then it must be diluted with 50 barrels of fresh water daily.

Plans call for the installation of an insulated water storage with electric heating cables in the tank, and a small high-pressure piston-type, electrically-driven injection pump completely housed in an insulated building. An installation of this type will be set at each well where necessary.

Salt water disposal, as mentioned before, is effected by evaporation in earthen pits. Since the wells on the northwest side of the Poplar River do not produce large quantities of water this method of disposal is quite satis-

Continued on Page 190

Formation fracturing is conventional procedure in completion and workover practices. However, for best results, zone characteristics must be studied and the correct technique applied. Here are some case histories showing how they are successfully . . .

Fracturing Formations In the Illinois Basin

By G. H. LINK, District Engineer, The Carter Oil Company, Carmi, Ill.

FORMATION FRACTURING in the Illinois Basin, as in other areas, involves isolation of the zone to be fractured and pumping into the formation a viscous fluid containing sand in suspension. Case histories specifically indicate that best results can be expected if the following factors are considered carefully in performing the fracturing treatment:

- Highest pumping rate as possible will insure maximum fracturing.
- Sand content in the fracturing fluid should be at least two pounds per gallon for best results. (Some treatments have been made with as much as 4½ pounds per gallon.)
- Formation to be fractured should be clean. Presence of mud, cement, paraffin or salt deposits tend to minimize success of job.

Fracturing Technique. Technique used in the Illinois Basin to fracture oil-bearing reservoirs may best be illustrated by citing a field example. This well, a portion of whose electric log is shown in Figure 1, originally was completed by shooting the Bethel sand in the open hole below 2026 feet. The Hardinsburg sand was opened through perforations from 1806-1818 feet, or 10 feet above the original oil-water contact. No stimulation treatment was applied to the Hardinsburg originally because of the underlying water.

Completion date was on July 26, 1949. In March, 1953, it was decided to hydraulically fracture the Hardinsburg. A plug was set below the perforated interval. A six-hour bailing test indicated a daily production potential of eight barrels of oil and no barrels of water from the Hardinsburg. A retrievable packer was run in on tubing and set at 1774 feet. This isolated the zone to be fractured.

After pumping 840 gallons of clean crude oil into the formation and starting in with the fracturing fluid, it was necessary to circulate out and reperforate the casing since the fracturing fluid would not go into the formation. Evidently scale deposits had formed on the casing perforations.

After reperforating from 1806-18 feet, 840 more gallons of crude oil were pumped into the formation at a maximum pressure of 1300 pounds per square inch. A total of 1500 gallons of fracturing fluid containing 1.3 pounds of sand per gallon were then pumped in, followed by 3300 gallons of crude oil. The maximum pressure was 1900 psi which dropped to 1400 psi. Injection rate was 150 gallons per minute. A pumping test taken one month after treatment indicated a potential of 195 barrels of oil and 23 barrels of water in 24 hours, an increase in oil production of 2300 percent.

Admittedly, this treatment gave exceptionally good results. It is pertinent, therefore, to consider the factors that contributed to the unusual success of this job. Six pertinent points were brought out by this well study.

1. The accumulated production per acre foot from this well was low compared with other wells draining the same reservoir.
2. A drill stem test taken while drilling through the Hardinsburg flowed oil in four minutes. Furthermore, the average horizontal permeability in this particular reservoir, as determined from cores, was approximately 470 millidarcys and the vertical permeability was 430 millidarcys. These data indicated that the reservoir contained a good sand capable of high producing rates.
3. The sand, as shown in the electric log, was relatively clean and thick.
4. The treatment was confined to an interval of only 12 feet.
5. Prior to treatment, there had been no water production reported. The lowest perforation was ten feet above the original oil-water contact.
6. A recent bottom-hole pressure survey indicated a reservoir pressure in excess of 200 pounds in the area of this well. Indeed, this was an ideal well for stimulation treatment.

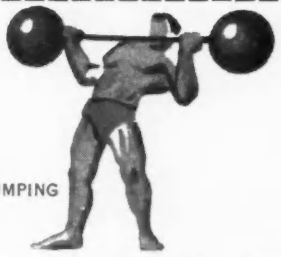
Case Histories. A review of other field examples will illustrate that a variation in one or more of these six conditions has resulted in a less favorable response to treatment.

Figure 2 tends to illustrate that good producers cannot be made by fracturing unless sand quality is favorable. This particular well which is draining the same reservoir as the previous well considered has a tighter,

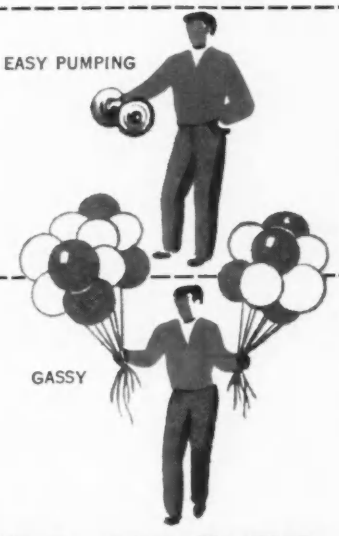
WHAT IS YOUR WELL CONDITION?

CORROSIVE

ABRASIVE


HEAVY PUMPING

HEAVY IMPACT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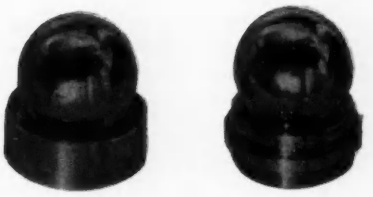

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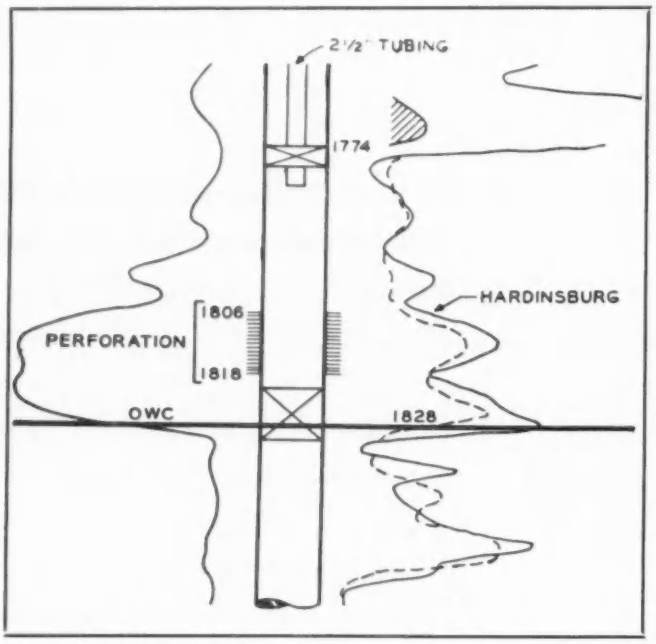


Fig. 1—Fracture treatment of this well included 840 gallons of crude oil followed by 1500 gallons fracture fluid with 1.3 pounds sand per gallon. Injection rate: 150 gallons per minute; pressure broke from 1900 to 1400 psi. Treatment followed with 3300 gallons crude injected at 1400 psi. Before treatment: 8 barrels oil, no water; after treatment: 195 barrels oil, 23 barrels water.

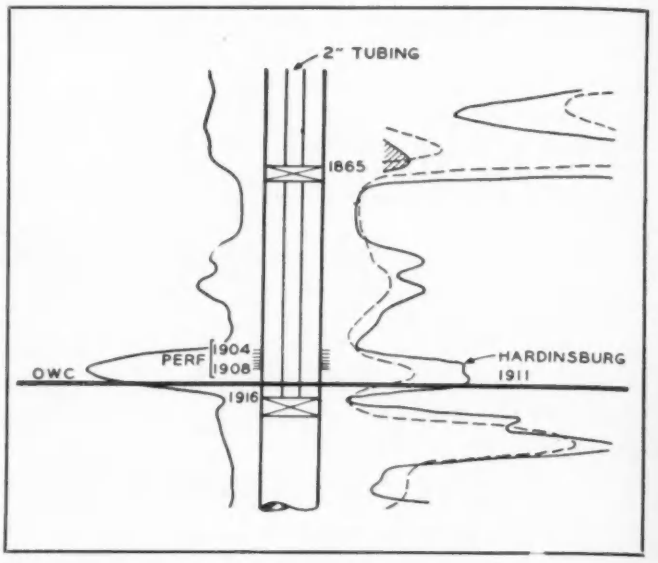


Fig. 2—This well treated with 840 gallons of crude pumped ahead at 1600 psi, followed with 1600 gallons fracture fluid with 0.4 pounds sand per gallon. Injection rate: 160 gallons per minute. Pressure increased from 1600 to 2400 psi. Treatment followed with 3300 gallons crude oil injected at pressures from 4000 to 1700 psi. Before treatment: 5 barrels oil, 1 barrel water; after treatment: 27 barrels oil, 26 barrels water.

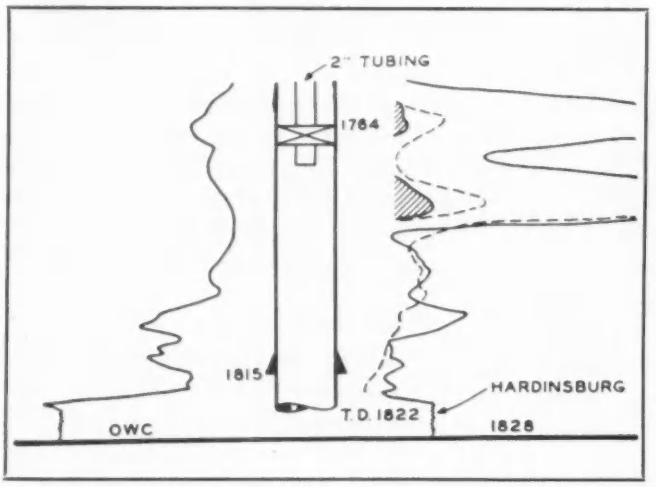


Fig. 3—Production after treating this well was 12 barrels oil, 80 barrels water; before treatment: 5 barrels oil, 8 barrels water. Well treated with 840 gallons crude at 800 psi, followed with 1600 gallons fracture fluid with 0.25 pounds sand per gallon, injected at 160 gallons per minute. Pressure broke from 1700 to 1400 psi. Treatment followed with 3000 gallons crude oil injected at pressures from 2000 to 1400 psi.

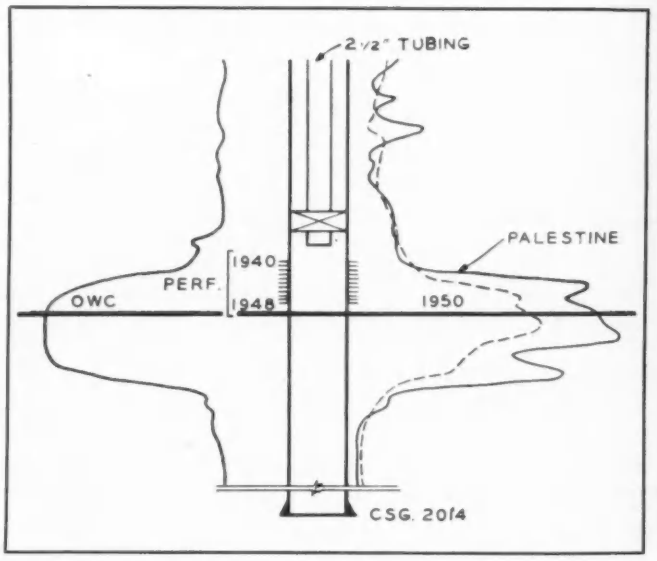
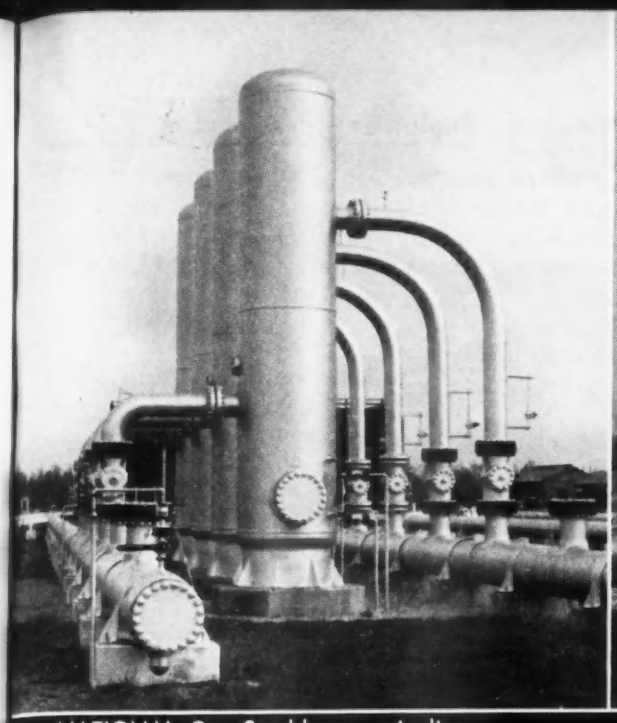


Fig. 4—A two-stage fracture treatment was made on this well. First stage included 840 gallons crude ahead at pressures from 2400 to 1700 psi; 1000 gallons fracture fluid with 1 pound sand per gallon, injected at 67 gallons per minute. Pressure broke from 2700 to 1500 psi. 1000 gallons crude followed at 1500 psi. Production increased from no oil to 11 barrels oil, 1 barrel water. Retreated with 840 gallons crude at 1800 psi, 800 gallons fracture fluid with 1.5 pounds sand per gallon, injected at 133 gallons per minute at pressures from 1950 to 1200 psi. 1500 gallons crude oil pumped in at 1400 psi. Production increase to 132 barrels oil plus 32 barrels water.

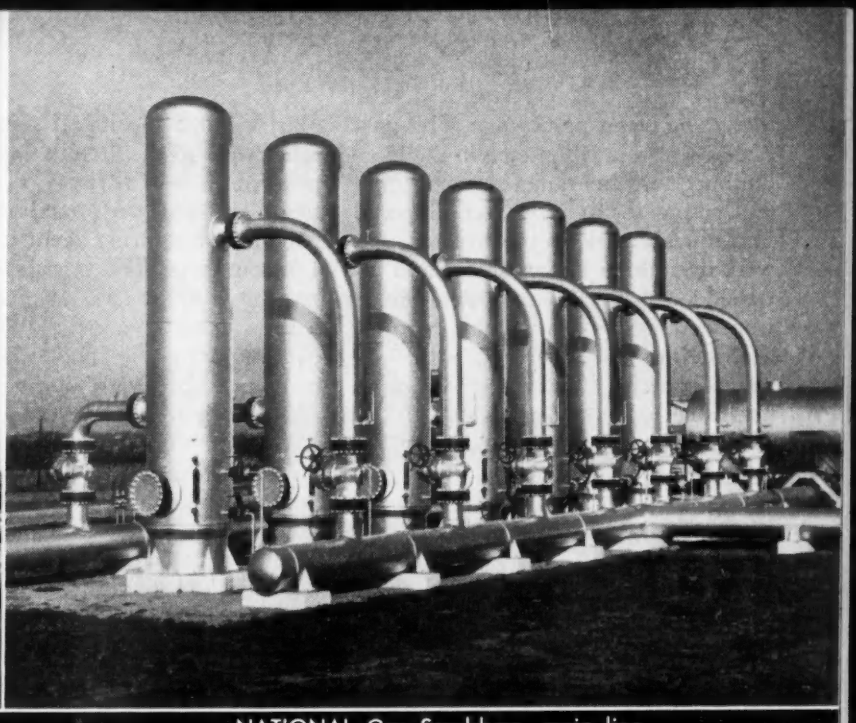
thinner sand, as shown by the electric log. The oil-water contact was three feet below the lowest perforation. The initial potential of the well was approximately five barrels per day.

In March, 1951, a decision was made to hydraulically fracture the Hardinsburg. A total of 1600 gallons of fracturing fluid containing 0.4 pounds of sand per gallon of fracturing fluid was utilized. The fracturing fluid started into the formation at 1600 psi and rose to 2400 psi. Pumping rate was 160 gallons of fluid per minute. The 3000 gallons of crude oil which followed the fracture fluid broke the formation from 4000 to 1200 psi. Production was increased from five barrels per day with one barrel of water to 27 barrels of oil and 26 barrels of water. However, based on current data, the cost of reconditioning has not and will not be returned.

Figure 3 illustrates the danger of



NATIONAL Gas Scrubbers, main line gas booster station, Batesville Miss.



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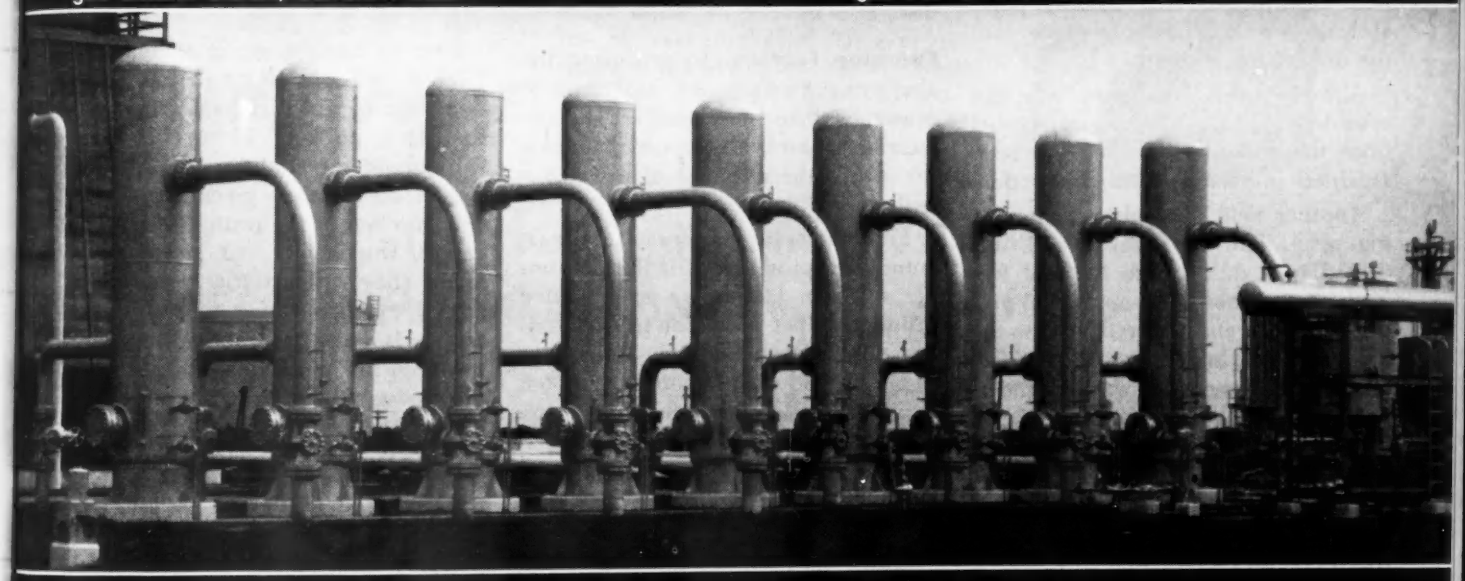

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increasing water percentage. This particular well was completed in the Hardinsburg in the same reservoir and had casing set at 1815 feet. Exposed immediately below the casing seat were over three feet of shaly sand interbedded with shale as determined from core descriptions. Total depth of the well was six feet above the oil-water contact. Other factors were favorable for a successful job.

The fracturing fluid broke down the formation at a pressure of 1700 psi with a final pressure of 1400 psi. Fracture fluid containing 0.25 pounds of sand per gallon was pumped in at a rate of 160 gallons per minute. Production was increased from five barrels of oil and eight barrels of water to 12 barrels of oil and 80 barrels of water. This indicates that even though over three feet of shaly sand and shale were present below the casing point at least one fracture was made into the underlying aquifer.

Although this treatment was not considered good, it was successful since the cost of fracturing has been returned in increased oil production.

Another field example is shown in Figure 4. This particular well was drilled to a total depth of 2847 feet in the Aux Vases. No commercial production was encountered below the Palestine so casing was set at 2014 feet through the sand due to underlying water. The Palestine tested 940 feet oil, 270 feet gas, and 30 feet oil-cut mud in four hours from 1938-50 feet with a bottom-hole pressure of 342 pounds. The sand which was cored in an offset well revealed a horizontal permeability of 500 millidarcys. The well was perforated from 1940-44 feet and tested dry after pulling vacuum with a casing swab for four hours. The interval from 1944-48 feet was also perforated and the entire interval tested dry.

Due to apprehension about the underlying water, only 800 gallons of fracturing fluid containing one pound of sand per gallon was pumped in at an injection rate of 66.6 gallons per minute. Although the fracturing media started in at 2700 pounds and broke to 1500 pounds, disappointing results were obtained. The well was swabbed for four days and all fluid used in the previous treatment was finally obtained, plus some mud and sand. During the last 24 hours the well swabbed 11 barrels of oil and one barrel of water.

In view of the initial potentials of other wells in the area, it was deemed prudent to refracture. The second treatment was performed using 800 gallons of fracturing agent containing 1.5 pounds of sand per gallon. Pressure broke from 1950 to 1200 pounds while pumping in at a rate of 133 gallons per minute. The well was then completed for a pumping potential of 132 barrels of oil and 32 barrels of water per day. In the second treatment on this particular well, three factors were changed: (1) amount of sand was increased from one to 1.5 pounds per gallon; (2) the bore hole had been thoroughly cleansed by the previous treatment; and (3) the injection rate was greatly increased.

Success of the second treatment is largely attributed to the increased injection rate plus the cleaner condition of the sand.

Examine Factors. In reviewing the above case histories, it is important to examine them in retrospect to determine if a check list can be made for use in the selection of a well for hydraulic fracturing.

First factor to be considered is accumulated production. If the well under question has a low accumulated production per acre-foot in comparison with other wells in the same reservoir, and the sand quality is good, it is definitely a candidate for hydraulic fracturing.

Second, all core and drill stems should be examined to determine sand quality.

Third, an electrical log should also be examined to determine thickness, quality, and position of water table.

Fourth, the interval opened for treatment should be examined with the thought in mind that a minimum interval should be opened to insure maximum fracturing benefits.

Fifth, the water production history of the well should be examined as well as the position of the water table. It has been demonstrated that water percentages, in general, will increase, and if the water table is near, there is a good possibility of fracturing into it.

Sixth, the bottom-hole pressure should be examined if data are available. Unless there is sufficient reservoir energy to force oil into the reservoir, a successful hydraulic fracturing job cannot be achieved. —**The End**

Poplar Unit Problems

Continued from Page 185

factory. Wells on the south side, however, produce a much greater percentage of water and its disposal is beginning to become a major problem.

Vehicle maintenance. Maintenance of vehicles in this area has been found to be quite expensive. A vehicle stays packed underneath with snow and ice approximately 4½ to 5 months a year, except for short intervals when the temperature is above freezing. Conditions have been such that vehicles must be steamed out underneath two or three times per week. The extra load on the vehicles by ice causes considerable breakage of springs, shock absorbers, and general deterioration of the vehicle throughout.

Due to the degree in which personal safety depends on the operating condition of a vehicle, it is necessary that they be kept in tip-top shape throughout the cold periods. For this reason, all units are given a thorough checkup before the winter begins and careful inspections and repairs are made throughout the winter. The record to date proves that this procedure is quite satisfactory for there has been no occasion in which an employe was incapacitated because of unnecessary exposure to the cold due to vehicle failure.

Oil treating. Although treating the crude presents a serious problem in several areas, it was found that emulsions could be broken by a combination of heating and filtering in the heater treaters, and by using one pint of chemical per 100 barrels of oil. Crude oil ready for shipment must contain less than 1 percent basic sediment and water. A small gas-driven chemical injector is provided in each treater house, and cehmical injection is automatic on a 24-hour basis.

Characteristics of the East Poplar Unit crude oil are as follows:

Gravity @ 60° F. 40.2° API
Sulfur .330%
Pour Point + 20° F.
Viscosity @ 70° F 40.6 Secs. Saybolt Univ.
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Color Brownish-Green
Initial Boiling Point 87° F.

—**The End**

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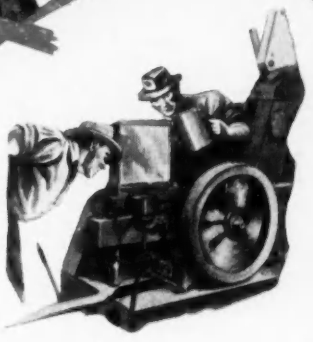

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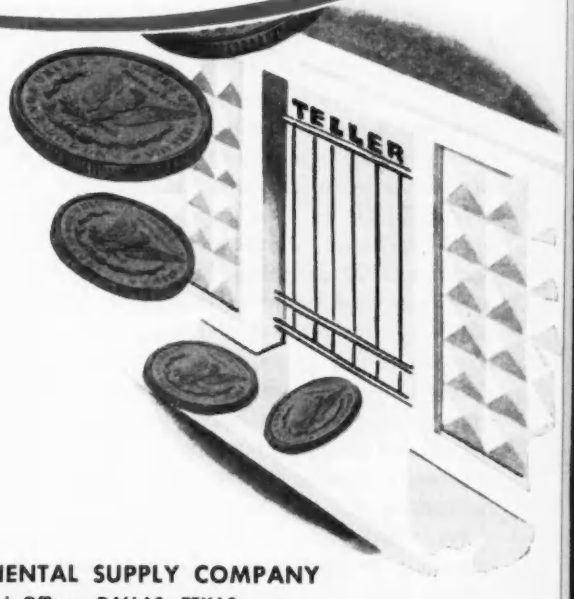

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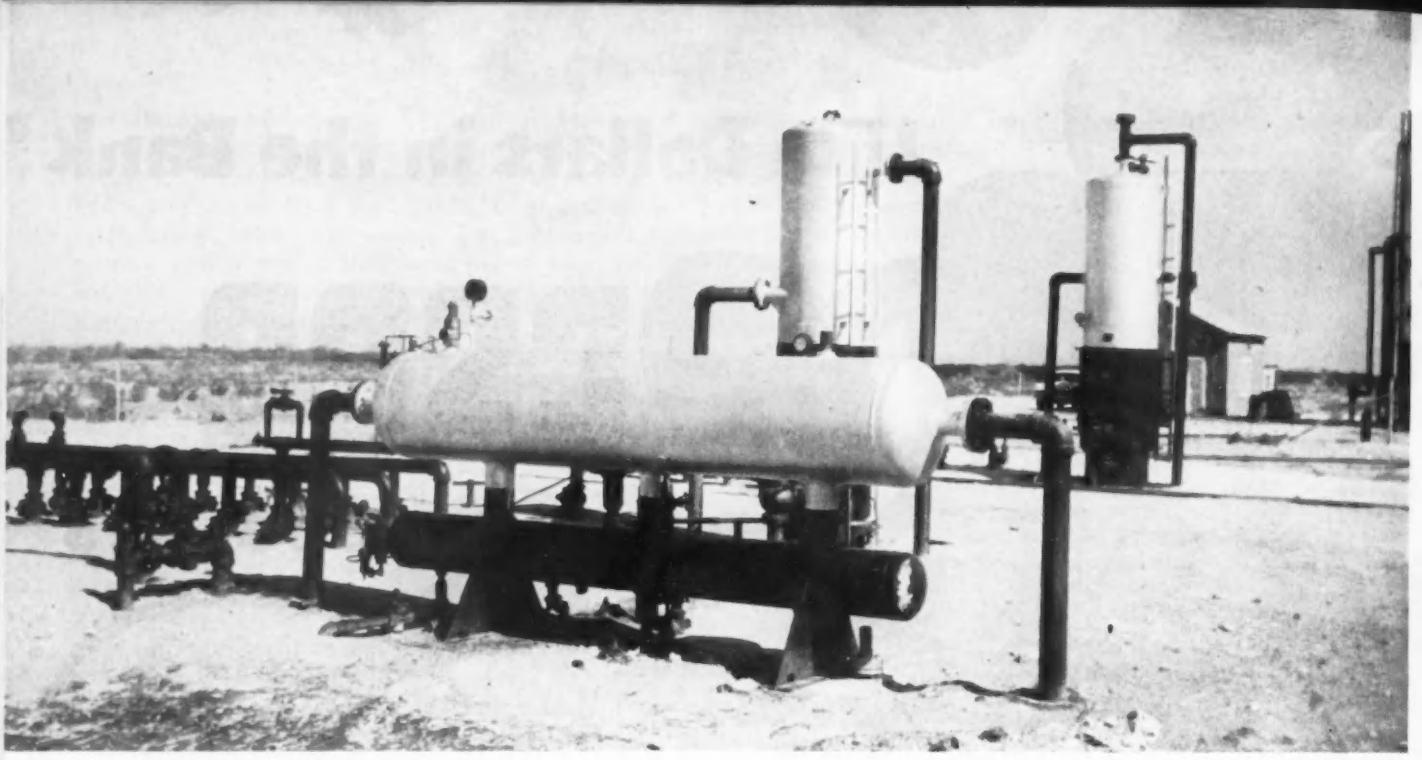

Fig. 1—Typical separator hookup in Block 31 field. In the foreground is a horizontal high-pressure separator for Devonian production. Behind are two low-pressure separators. One at left handles Devonian crude. The other is for Ellenburger production.

A new idea of oil recovery by high-pressure gas injection was introduced to the industry by The Atlantic Refining Company back in 1949. How has the project in West Texas performed? What is its current status? It's all told in a review of . . .

Five Years of High-Pressure Gas Injection in the Block 31 Field

By V. M. HOLLRAH, R. E. HOWARD and E. F. HERBECK, The Atlantic Refining Company

A PROGRAM for increasing oil recovery by the injection of gas at high pressure was initiated in June, 1949, in the Block 31 Devonian Reservoir in West Texas. A paper[1] was published in 1952 describing the program as it was then being carried out and outlining the plans for ultimate expansion to full pressure maintenance. Since then, the installation of the required injection facilities has been completed and the plans for full pressure maintenance have been put into operation.

As initially conceived, the program entailed the injection of gas produced from the Block 31 Devonian and Ellenburger formations into the crest of the Devonian reservoir to retard the pressure decline. However, additional laboratory studies indicated a marked advantage for fully maintaining pressure and with a revision of plans the program was expanded on Oct. 1, 1952, to full pressure maintenance.

With the commencing of full-pressure maintenance, it was necessary to supplement the produced gas with a nearly equal volume of outside gas so as to balance the reservoir voidage. At present 31,600,000 cubic feet of gas per day are being injected into a total of thirteen injection wells with production of 13,500 barrels of oil per day.

The operation of the injection program, to date, has been highly satisfactory. Although it is still too early in the life of the program for the high-pressure gas recovery mechanism to be evaluated, gas has not broken through into any of the producing wells and reservoir performance has been as expected.

Reservoir rock and fluid characteristics. The Devonian formation in this field is structurally an anticline encountered at a depth of 7900 feet with a gross thickness of approximately 1000 feet. The main oil producing section is in the interval from 450 to 800 feet below the top of the

Devonian. Up to 185 feet of this section is net pay in some of the structurally higher wells. The reservoir rock and fluid characteristics were previously described in the above mentioned paper[1] and are summarized in the following tables:

ROCK CHARACTERISTICS

Formation	Calcareous and Dolomitic Sand
Average Porosity	15 Percent
Average Effective Permeability	1 Millidarcy
Average Connate Water	37 Percent

FLUID CHARACTERISTICS

Reservoir Temperature	139° F.
Initial Reservoir Pressure	4145 psig
Saturation Pressure	2764 psig
Gas Solubility at Saturation Pressure	1212 SCF/Bbl.
Viscosity @ Saturation Pressure	0.30 Centipoise
Formation Volume Factor at Saturation Pressure	1.69 barrels/barrel
Oil Gravity	46° API

History prior to full pressure maintenance. The Block 31 Field was discovered in November, 1945. During the 3½ years from the field discovery until the start of gas injection, 3.7 million barrels of oil were produced with a decline in reservoir pressure from the initial value of 4145 psig to 3650 psig. In June, 1949, the injection program was begun by injecting about 3,000,000 cubic feet of gas per day into the C-2 well, located near the center of the field on the crest of the structure. Another well, the P-2, was placed on injection in January, 1950. Because of subsequent increases in produced gas rate, a third well, the A-2, was converted to injection in May, 1951. At the same time, the compressor plant was enlarged from three compressors with a combined horsepower of 2400, to four compressors with a combined hp of 3280, capable of delivering approximately 9,000,000 cubic feet of gas per day at 4000 pounds per square inch.

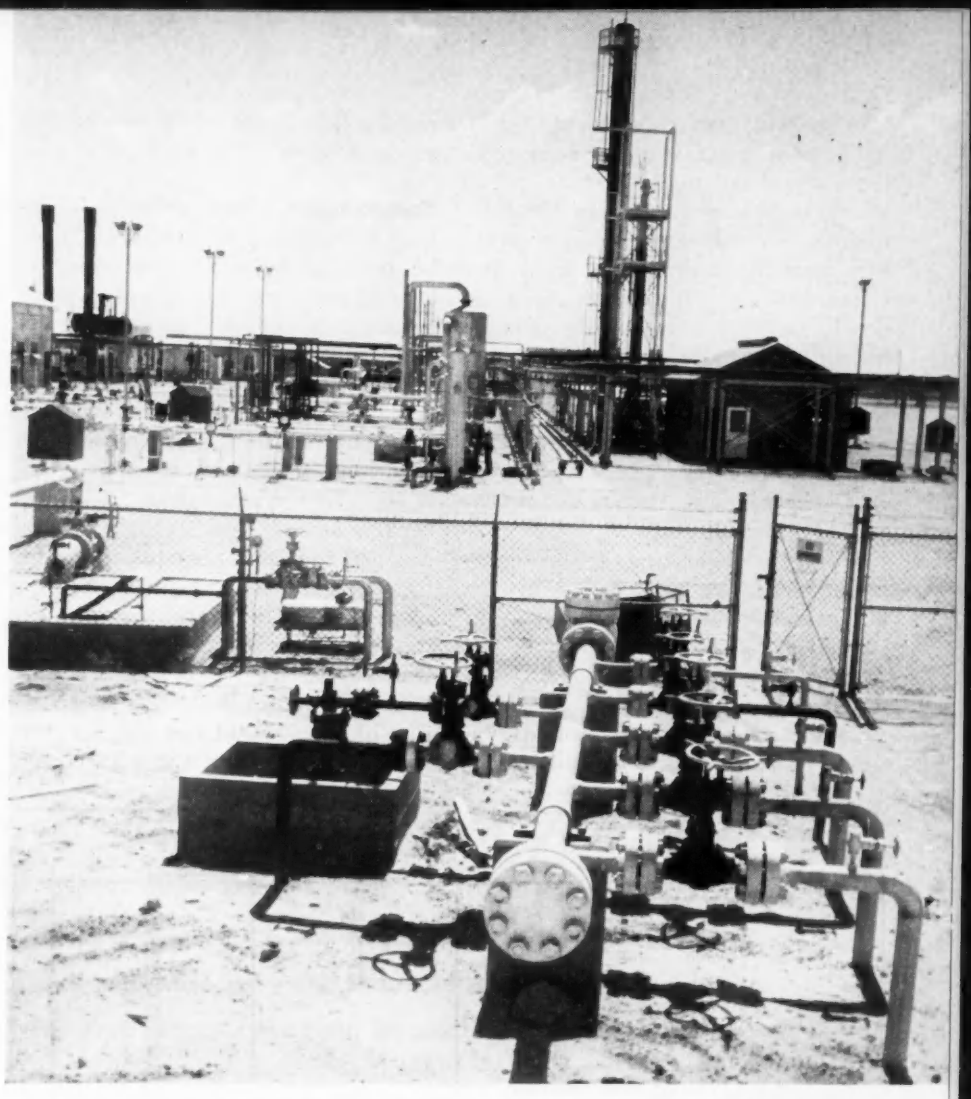

Fig. 2—Injection gas header. Gas is discharged from compressors at 4000 psi into this header from where it is distributed to injection wells. A portion of the plant is shown in background.

Fig. 3—Gas scrubber used to remove solids and liquids from injection gas. Gas enters scrubber at right and leaves through outlet at top. Foreign matter is removed through drain at bottom.

The original intent of gas injection was to inject the field produced gas into two or three wells along the crest of the structure to provide partial pressure maintenance in the reservoir, maintain productivity, and increase oil recovery. But, when laborary research demonstrated the large additional recovery that could be obtained by the high pressure gasinjection,[2,3] consideration was given to expanding from partial pressure maintenance to full pressure maintenance.

History of full pressure maintenance. A reservoir analysis established that the high-pressure gas injection process could be applied advantageously to the Block 31 Devonian, and it was decided in the early part of 1951 to expand to full-pressure maintenance. The reservoir analysis showed that because of the

low reservoir permeability, the original plan of injection at the structural crest would not maintain pressure at the flanks. Consequently, in order to maintain a satisfactorily high pressure over the entire reservoir, it was concluded that the injection wells should be dispersed over the field in the nine-spot pattern shown in Figure 4. In addition, this pattern provides the proper ratio between injection and producing wells such that efficient sweep of the reservoir can be realized while maintaining a satisfactory rate of recovery.

Upon the request of the unit operators, a hearing was called by the Railroad Commission of Texas in August, 1951, and the application for permission to undertake full pressure maintenance in the Block 31 Devonian was submitted. The commission granted this permission and recognized a field MER which was related to the volume of gas injected.

Compressor plant enlarged. Before full-pressure maintenance could be undertaken, it was necessary to enlarge the compressor plant, provide a source of outside gas, and convert additional producing wells to injection. By October, 1952, five 880-hp compressors had been added bringing the plant up to its present total of nine compressors with a combined hp of 7680. At the same time, outside gas became available and sufficient progress had been made in equipping wells for injection, that full-pressure maintenance could be instituted. The initial full-pressure maintenance MER was 10,000 barrels of oil per day, with a commensurate gas injection rate of 20,250,000 cubic feet per day. About 45 percent of the injected gas was purchased from outside the field.

Increases in the MER were made as the injection capacity of the field was increased by the conversion of additional producing wells to injection wells. By January, 1953, with 12 wells on injection, the Devonian producing rate was 13,000 barrels of oil per day with a corresponding gas injection rate of 27,280,000 cubic feet per day. In June, 1953, the N-3 well was drilled and completed as an injection well. This completed the system of 13 injection wells shown on Figure 4. In September, 1953, the MER was increased to the present rate of 13,500 barrels of oil per day.

An analysis of reservoir performance indicated that the previously estimated small water drive in the Devonian was becoming ineffective. This necessitated increasing the gas injection rate in order to balance the reservoir voidage. At present, 31,600,000 cubic feet of gas per day are being injected.

As shown in Figure 5, a total of 21 billion cubic feet of gas has been injected into the reservoir as of Jan. 1, 1954, and a total of 17 million barrels of oil produced. Of this amount 13.5 million barrels have been produced since injection began. Since full-pressure maintenance began on Oct. 1, 1952, 13 billion cubic feet of gas have been injected and 5.5 million barrels of oil produced.

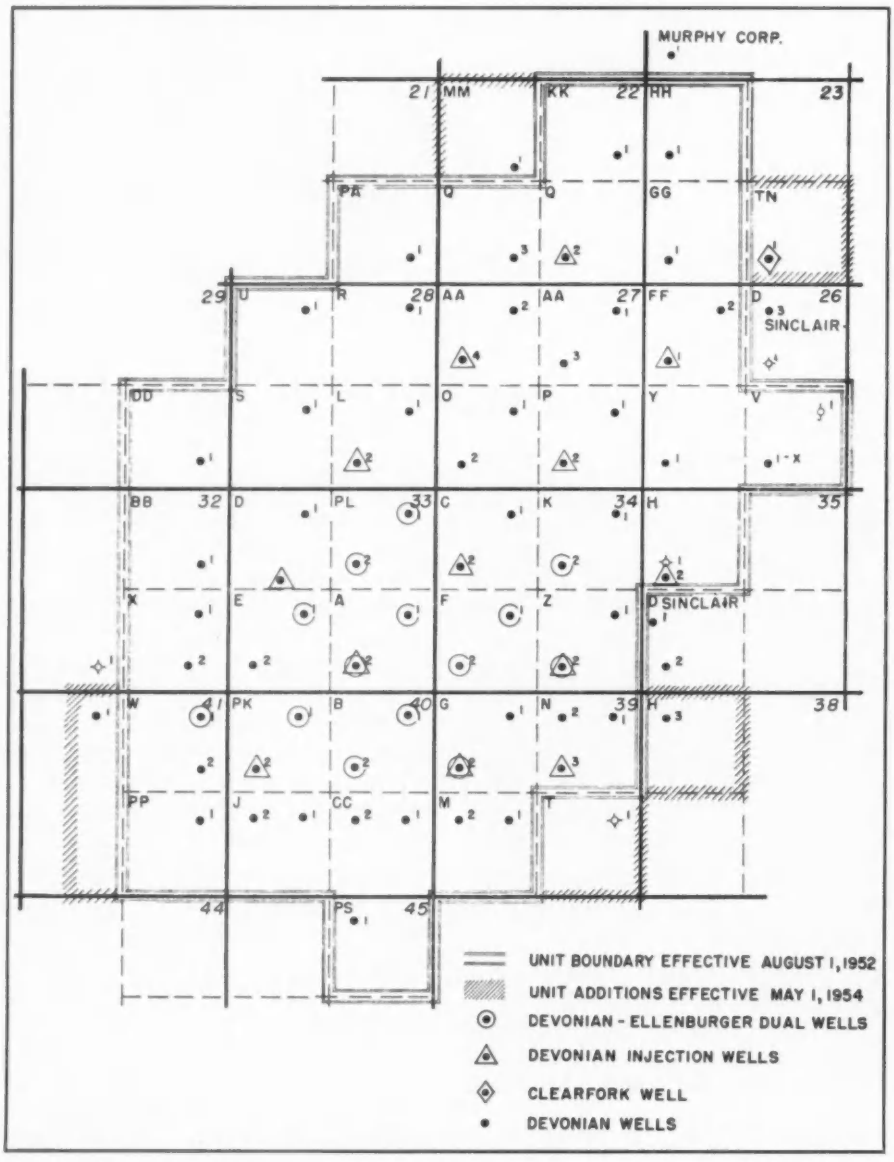

Fig. 4—Current field status of Block 31 field of Crane County, Texas, as of May 1, 1954.

Devonian field development. The development of the Devonian field is essentially complete with the present 70 wells. All but four of the wells lie within the Block 31 Unit boundary. The unit was officially established on Aug. 1, 1952. Prior to this time, the injection program was operated under a joint operations agreement entered into on Jan. 1, 1948, when four operators pooled their interest in the field. This combining of interest was simplified by the fact that there was only one royalty owner in the field, the University of Texas.

In order for the high-pressure gas injection process to operate properly, it is essential that the pressure at the gas-oil interface be maintained in excess of 3500 pounds per square inch gauge. Because of this fact, considerable time has been spent in conducting and analyzing the annual bottomhole pressure tests. The determination of actual reservoir pressure has been complicated by the low permeability of the reservoir which causes

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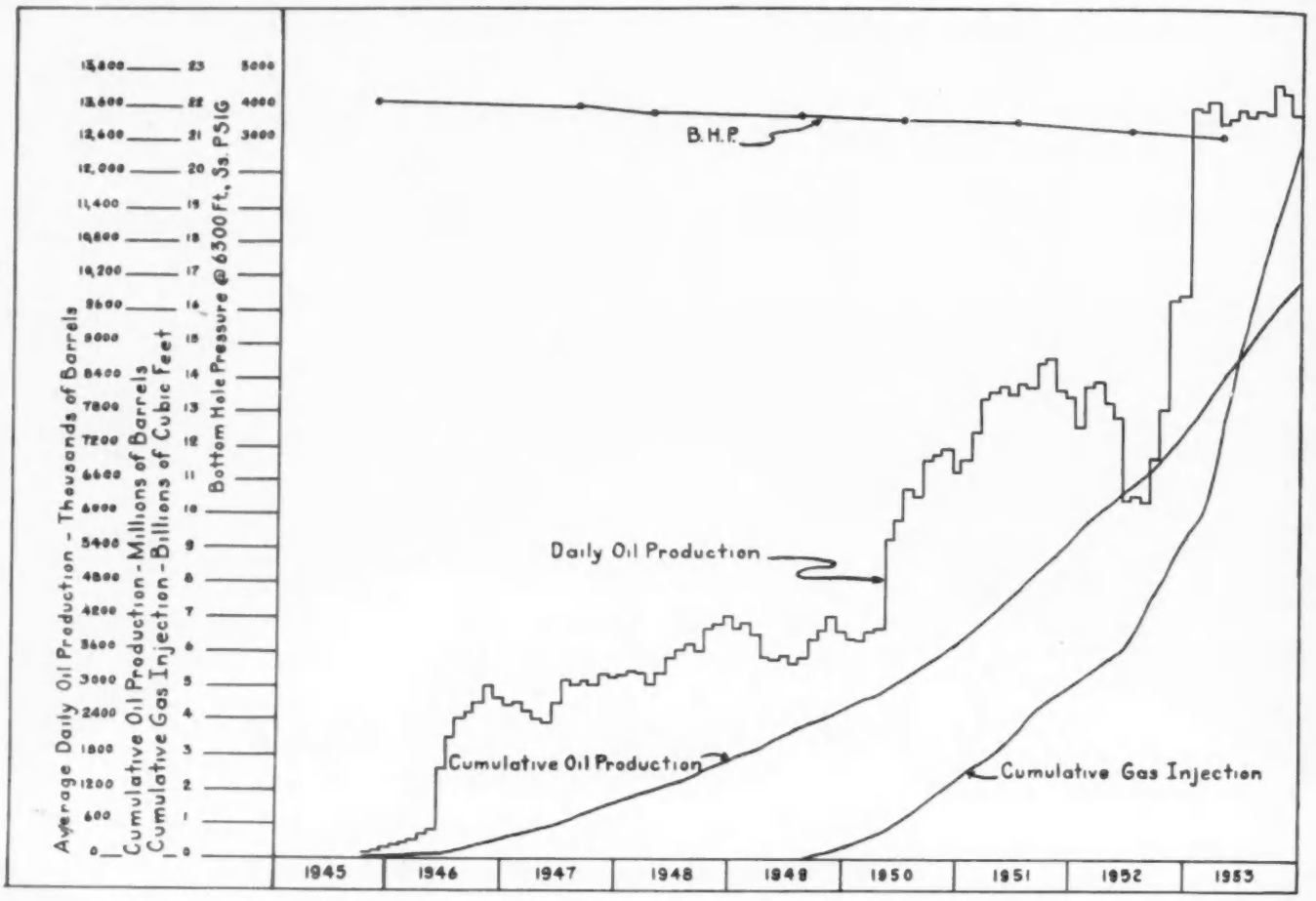


Fig. 5 (above)—Reservoir performance history of Block 31 field. High-pressure gas injection commenced in 1949.

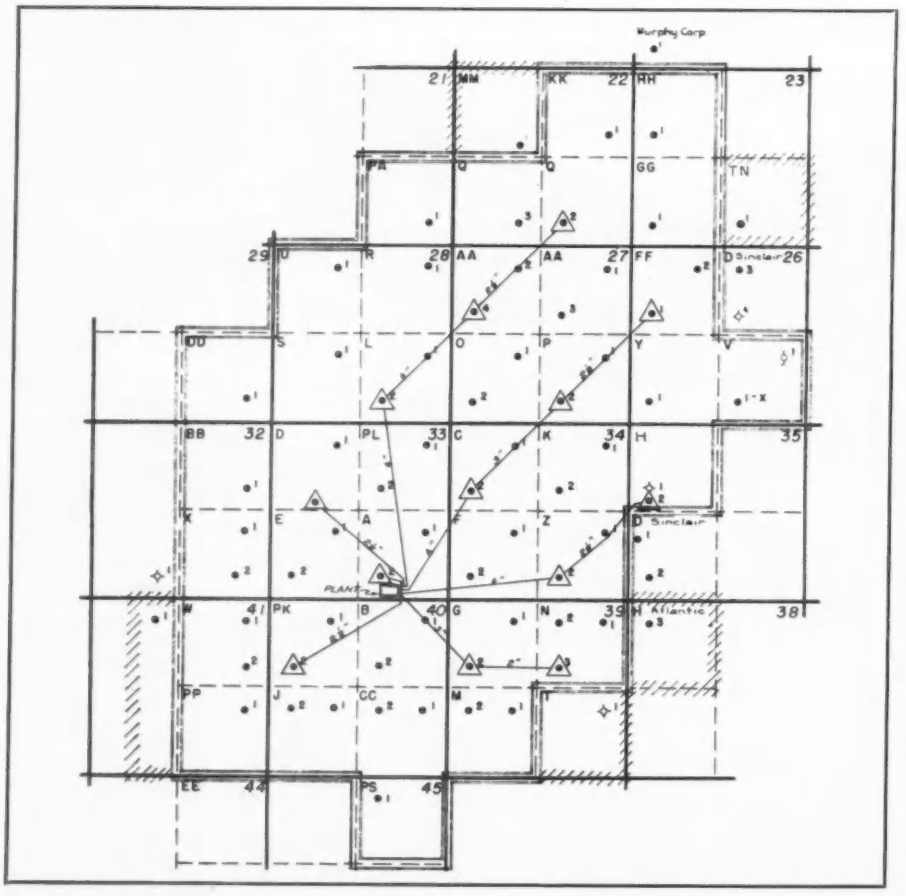
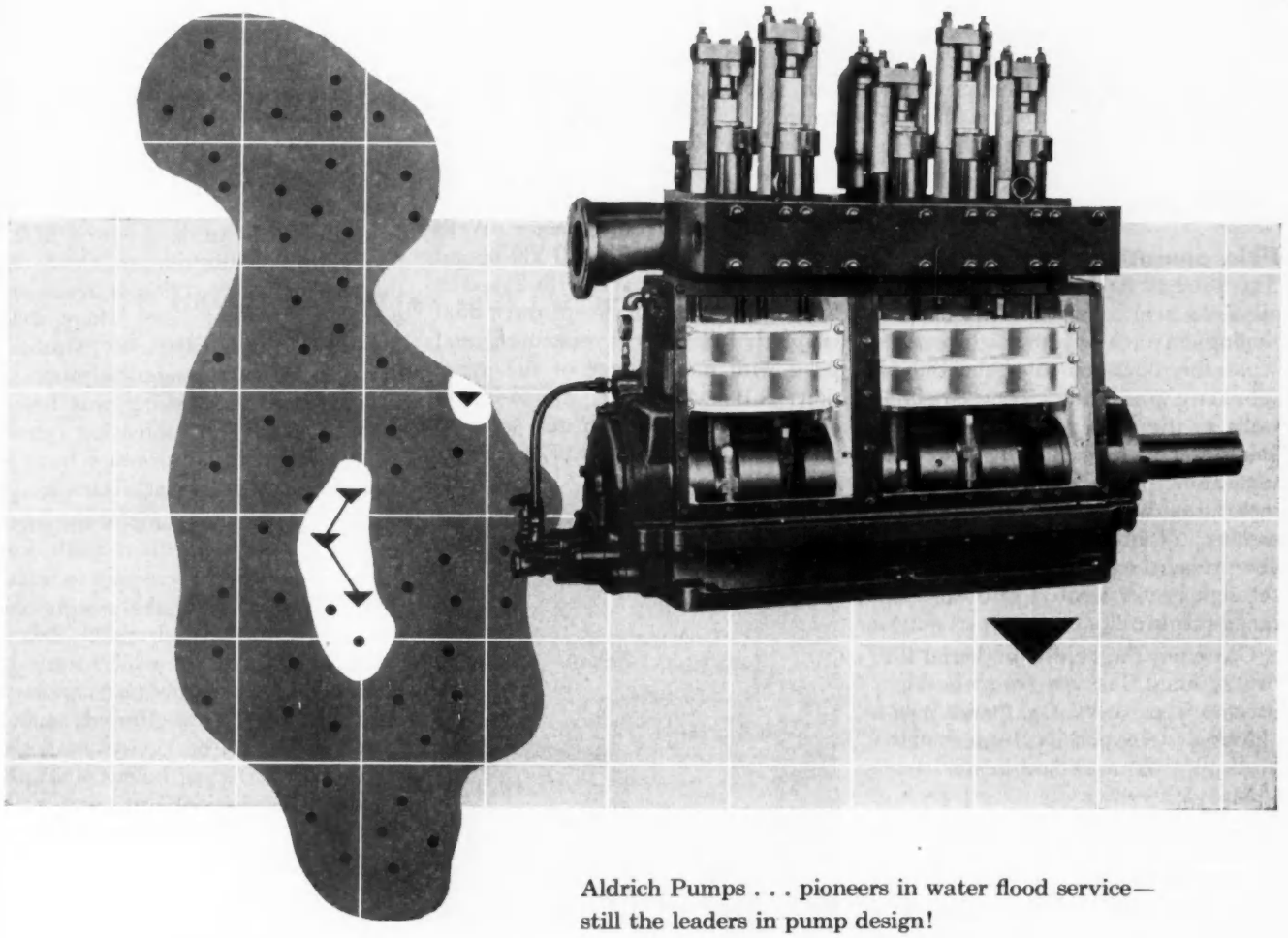


Fig. 6 (left)—Gas injection distribution system in Block 31 field as of May 1, 1954.

inordinately long periods of pressure buildup. The procedure followed in taking bottom-hole pressure tests is to record the flowing bottom-hole pressure, shut the well in, and record the pressure buildup over a 3 to 7-day period depending on characteristics of individual wells. With these data the pressure buildup curve can be extrapolated to the actual reservoir pressure using the method of Miller, Dyes, and Hutchinson.[4]

The pressure survey conducted in April, 1953, showed the volumetrically averaged pressure of the reservoir to be 3160 psig as indicated in Figure 5. However, the pressure at the gas-oil interface has been calculated to be over 4000 psig. By maintaining the present volume ratio of gas injection to reservoir voidage, the gas-oil interface pressures will decrease only slightly as the gas front expands from the injection well. As the expansion of this high pressure



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gas-swept volume takes place, the over-all average reservoir pressure will increase. In fact, some of the producing wells near the center of the field, where injection has been in progress the longest, have shown increases in reservoir pressure over the previous survey.

Field operations and equipment. The present field practice is to flow all wells which have sufficient producing capacity into high-pressure separators operated at about 150 psi working pressure. The remaining wells in the field, along with the oil being staged from the high-pressure separators, produce into low-pressure separators which have a working pressure of about 25 psi. From the low-pressure separators, the oil passes through heater treaters into the stock tanks (Figure 1).

Gas from the field is gathered into two systems. The gas from the high-pressure separators is gathered into a 125 psi system, and gas from the low-pressure separators and heater treaters is gathered into a 5 psi system. Of the total field gas, about ⅔ is produced into the high-pressure system. On entering the compressor plant, the 125 psi gas is compressed in three stages, and the 5 psi gas in four stages, to 4000 psi discharge pressure. In addition to the field gas, purchase gas is obtained at about 600 psi and is compressed in two stages to 4000 psi.

Operation of the compressor plant has been highly satisfactory to date with all compressors being operated at about 98 percent of full time. With this efficiency, the plant is capable of delivering a combined total of slightly over 33,000,000 cubic feet of gas per day at 4000 psi discharge pressure. Except for a portion of the gas used for plant and lease operations, all gas produced by the unit operators is returned to the Devonian reservoir. Incidental to the compression and cooling of the gas, approximately 16,000 gallons per day of 26-pound Reid vapor pressure gasoline are recovered.

The injection gas is discharged from the compressors to a common header. Seven lines branching from the header distribute the gas to the injection wells (Figures 2 and 6). Before entering the injection wells, the gas is passed through a high-pressure scrubber located near the injection wellhead to remove any solids or liquids which may be in the gas (Figure 3). The foreign matter collects in the bottom of each scrubber and is removed by periodic blowdowns.

The quantity of gas that is injected into each well is regulated by an adjustable choke at the well head and is recorded by an orifice meter. Wells are equipped with a 10,000-pound test christmas tree and with 2½-inch N-80 tubing. On all except three dual wells, the annulus is packed off and filled with mud. Three of the injection wells, A-2, G-2, and Z-2, are dual completions which also serve as oil producers from the Ellenburger

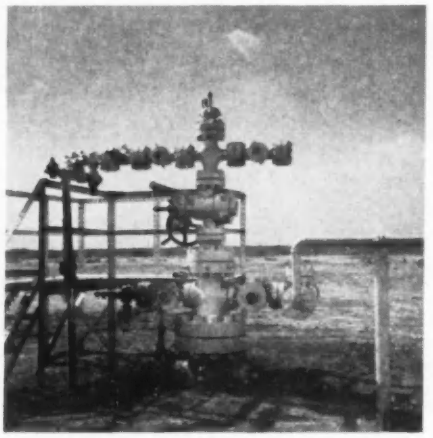

Fig. 7—Christmas tree on dual well. Gas is injected through the tubing-casing annulus into Devonian formation. Oil from Ellenburger formation is produced through tubing.

reservoir (Figure 7). These wells are equipped with a string of extra heavy 5½-inch casing cemented inside the initial production string of 7-inch. Gas is injected into the Devonian reservoir through the annulus of tubing and 5½-inch casing while oil is produced from the Ellenburger through the tubing. In addition to these, 12 other wells are dual producers from the Devonian and Ellenburger reservoirs.

Pattern balance. One of the most important requirements in the operation of the program is to maintain pattern balance. Periodic checks are made on the amount of gas that has been injected into each well and the remaining volume of oil to be swept in each pattern. From this information it is determined what adjustments should be made in the distribution of injection and producing rates to obtain the best sweep efficiency. Potentiometric model studies are made to supplement the calculated results.

It has been necessary to increase the capacity of some of the injection and producing wells by acidizing. On most wells a batch of from 3000 to 5000 gallons of regular acid is used. Injection wells are backflowed a few hours after acidization to clean out the well before injection is again undertaken. In some cases where wells showed declining injectivity, washing the sand face with water by pumping in and then backflowing was found to be successful in increasing capacity. However, this procedure has not been as successful as acidization.

The injectivity of some of the more limited capacity injection wells was observed to be very sensitive to injection pressure. When the compressor discharge pressure dropped below 4000 psi, the rate at which some of the wells took gas dropped considerably. Therefore, an effort is maintained to keep the pressure at the plant from dropping below 4000 psi. Because fluctuations in pressure would occur as gas availability changes or when compressors are shut down, a system has been devised whereby the PK-2 injection well is adjusted to absorb these fluctuations and keep the remainder of the injection system at constant pressure. The PK-2 well has sufficient capacity that cut backs in its injection rate can be easily made up when conditions in the compressor plant permit.

The reservoir performance has been as expected, the gas-oil ratios have remained practically constant at 1300 to 1. This shows that there has been no breakthrough of gas to producing wells. Although it is still too early in the life of the project to make a reservoir evaluation of the high-pressure gas recovery mechanism, operation of the injection program to date is considered to be very satisfactory.

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[4] Miller, C. C., Dyes, A. B., and Hutchinson, C. A., Jr., "The Estimation of Permeability and Reservoir Pressure from Bottom Hole Pressure Build-Up Characteristics," T. P. 2849, Trans. AIME, April, 1950.

—**The End**

New Water-Flood Tracers Prove Successful

Iodide and copper salts can now be added to the list of successful tools in tracing the flow of injected water through flooded formations.

By A. W. GARST and B. B. WOOD,
Stanolind Oil and Gas Company, Tulsa

FIELD TESTS indicate that iodide and copper salts can be added to a growing list of successful tools as tracers of injection water in waterflooding. Iodide salts in the form of sodium iodide made possible quantitative analysis of produced waters to calculate the volume of injection water produced. Analytical methods used are simple and are designed for use in the field. Copper salts as copper sulfate were useful in qualitative tests. Some interference with colorimetric tests were observed, and it is believed that the copper sulfate tracer escaped detection in many samples of produced water. Practical results from iodide salts may be limited in certain fields where the iodide content of the formation water is sufficiently low to permit use of the relatively expensive iodide tracer.

The iodide tracer was detected in produced waters by means of a semiquantitative analytical method and excellent results were obtained which appear comparable to the results reported for the use of boron[1] as a tracer. Field tests reported by the Pennsylvania Grade Crude Oil Association laboratory show that fluorescein, sodium chloride and a surface active agent could be used as water flood tracers under certain conditions.[2] The copper tracer was successfully detected using a qualitative test. Interference with the test for copper was frequently observed, and it is believed that this tracer was not detected in all of the produced water samples in which it may have been present.

All of the salt water injected in the field test of these tracers was obtained from a single supply well which provided a quite uniform flood water during the entire test period. The injection of tracer-marked water and subsequent production of tracer containing water can be followed by reference to the map shown in Figure 1.

Five parts per million by weight of copper were added as copper sulfate solution to the 14,665 barrels water injected at well 2 between March 10, 1952 and March 20, 1952.

Five parts per million by weight of iodine, added as sodium iodide solution, were added to the 16,668 barrels of water injected at well 1 between April 2, 1952 and April 27, 1952.

Ten parts per million of iodine as sodium iodide were similarly added to the 5520 barrels of water injected at well 8 during the period between Nov. 15, 1952 and Nov. 23, 1952. This second use of iodide tracer at the higher concentration was made in an effort to confirm the rapid movement of fluids which was suspected to exist between wells 8, 10, 11, and 12.

Copper tracer was detected in the water produced from wells 9, 11, 12, and 13. Appearance of the copper tracer was observed at the times shown in Table 1. Only in the case of water produced from well 11 did the copper tracer appear in what seemed to be increasing amounts over a period of several days as shown in Table 2. Interference with the colorimetric test for copper was apparent in many of the tests and it is believed that the copper tracer escaped detection in many samples of produced water.

Initial detection of iodide tracer was obtained at the times shown in Table 3. The iodide tracer which appeared in water produced from wells 4, 5, 6, and 9 unquestionably originated from well 1 where five parts per million iodine as sodium iodide had been added to the flood water.

Water produced from wells 10, 11, 12, and 13 was at least in part composed of water injected in well 8 as indicated by the higher maximum iodine content found at times in the water obtained from these wells. The exact source of water eventually produced from well 8 is uncertain be-

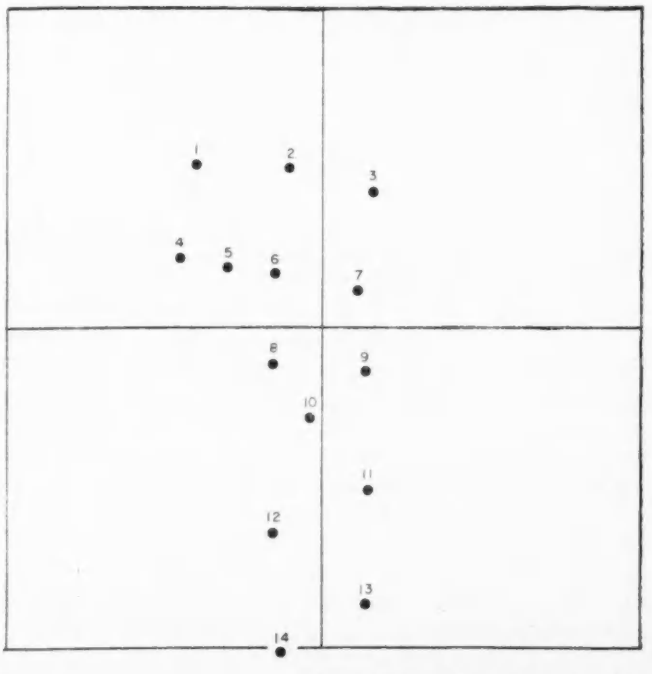

FIGURE 1

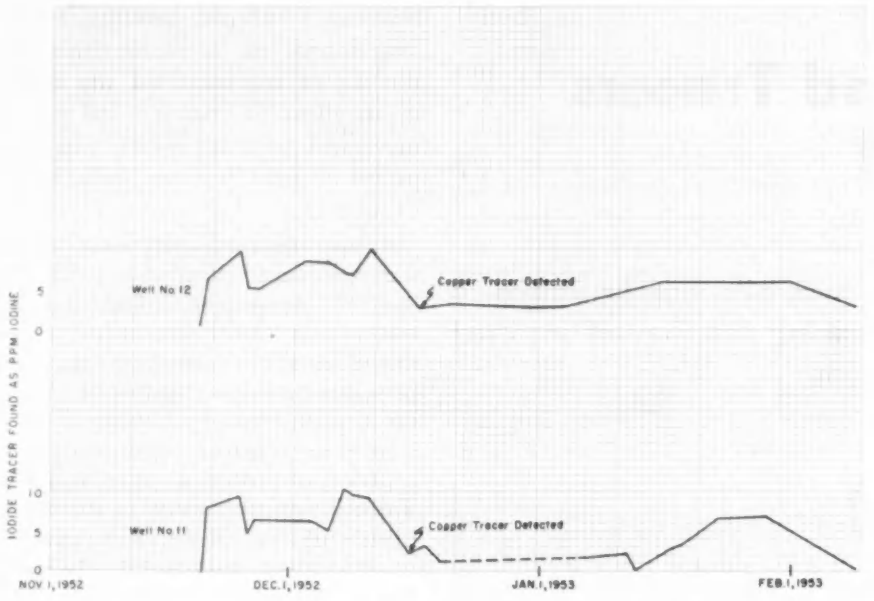

FIGURE 2

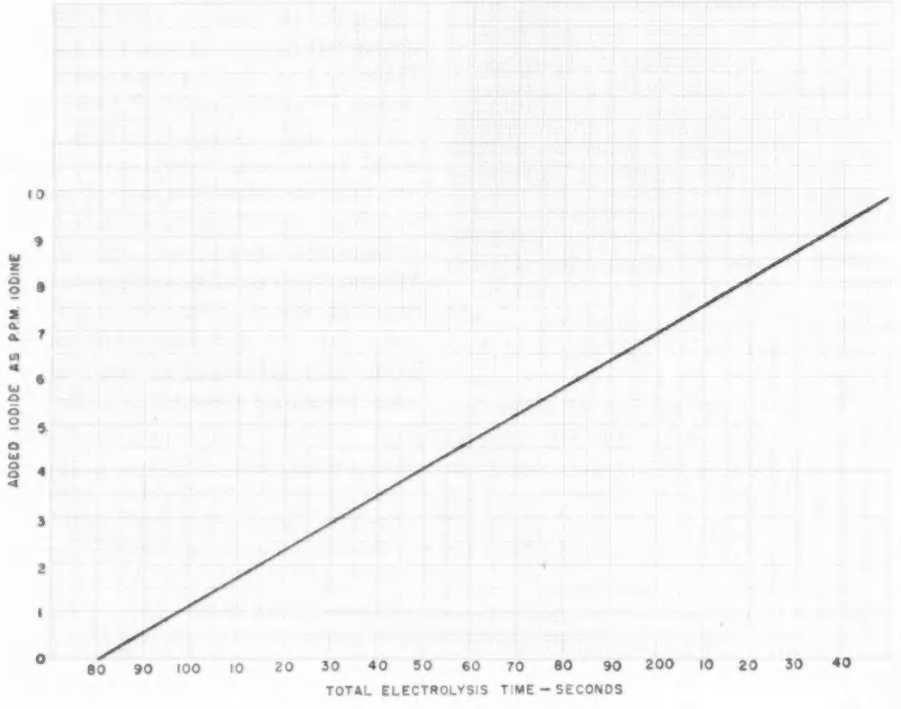

FIGURE 3

cause water containing iodide tracer had previously been injected in this well.

Appearance of iodide tracer accompanied the very first water samples obtained from wells 11 and 12. In the case of all other wells, the appearance of iodide tracer was gradual. Variations of iodine content in the water produced from Wells 11 and 11 are shown in Figure 2. The parallel between the iodide tracer content of the waters produced from wells 11 and 12 is quite pronounced.

During the period of Nov. 19, 1952, through Dec. 16, 1952, a total of 870 barrels of water was produced from well 11 and 346 barrels of water were produced from well 12. If it is assumed that all of the iodide tracer which appeared in these wells during this period had originated in the water injected in well 8, then it can be calculated that the water produced in this period from well 11 represented 9.4 percent of the tracer-marked water previously injected in well 8. The same assumption and calculation indicate that only 4 percent of the water injected in well 8 was produced out through well 12 during the same period.

An additional 10,425 barrels of water containing no added iodide tracer were injected in well 8 between Dec. 30, 1952 and Jan. 21, 1953. This apparently resulted in the movement of more iodide tracer out of the formation as indicated by the rising iodide content of the water produced in both wells 11 and 12 from Jan. 4, 1953 through Feb. 1, 1953. Origin of this second wave of iodide tracer is somewhat obscure as there appears to be some reason to believe that this second wave of iodide tracer may have originated in the water originally injected in well 1. The appearance of copper tracer in water produced from wells 11 and 12 would indicate that water had moved to these wells from well 2 where the copper tracer had been added to the injection water. The appearance of

TABLE 1

Appearance of Copper Tracer in Produced Water

Well No.	Date Copper Test First Obtained	Number of Samples Showing Presence of Copper
9	December 10, 1952	1
11	December 15, 1952	3
13	January 6, 1953	1
12	December 16, 1953	3

TABLE 2

Appearance of Copper Tracer in Water Produced from Well No. 11

Sampling Date	Copper Test
December 10, 1952.....	Negative
December 15, 1952.....	Faint Positive
December 17, 1952.....	Faint Positive
December 19, 1952.....	Faint Positive
January 6, 1953.....	Positive
January 11, 1953.....	Negative

TABLE 3

Appearance of Iodide Tracer

Well No.	Date of First Trace Iodide	Date of Maximum Iodide Content	Maximum Added Iodide Content Found
14	April 1, 1953	April 18, 1953	5.5 ppm
5	Oct. 22, 1952	Nov. 28, 1952	6.2
9	Dec. 12, 1952	Jan. 7, 1953	3.4
4	Jan. 8, 1953	Jan. 14, 1953	4.0
6	Oct. 31, 1952	Nov. 31, 1952	6.0
8	Dec. 8, 1952	Dec. 8, 1952	5 7
10	Dec. 18, 1952	Jan. 19, 1953	6.3
11	Nov. 20, 1952	Dec. 7, 1952	10.0
13	Nov. 25, 1952	Mar. 18, 1953	4.2
12	Nov. 20, 1952	Dec. 10, 1952	9 7

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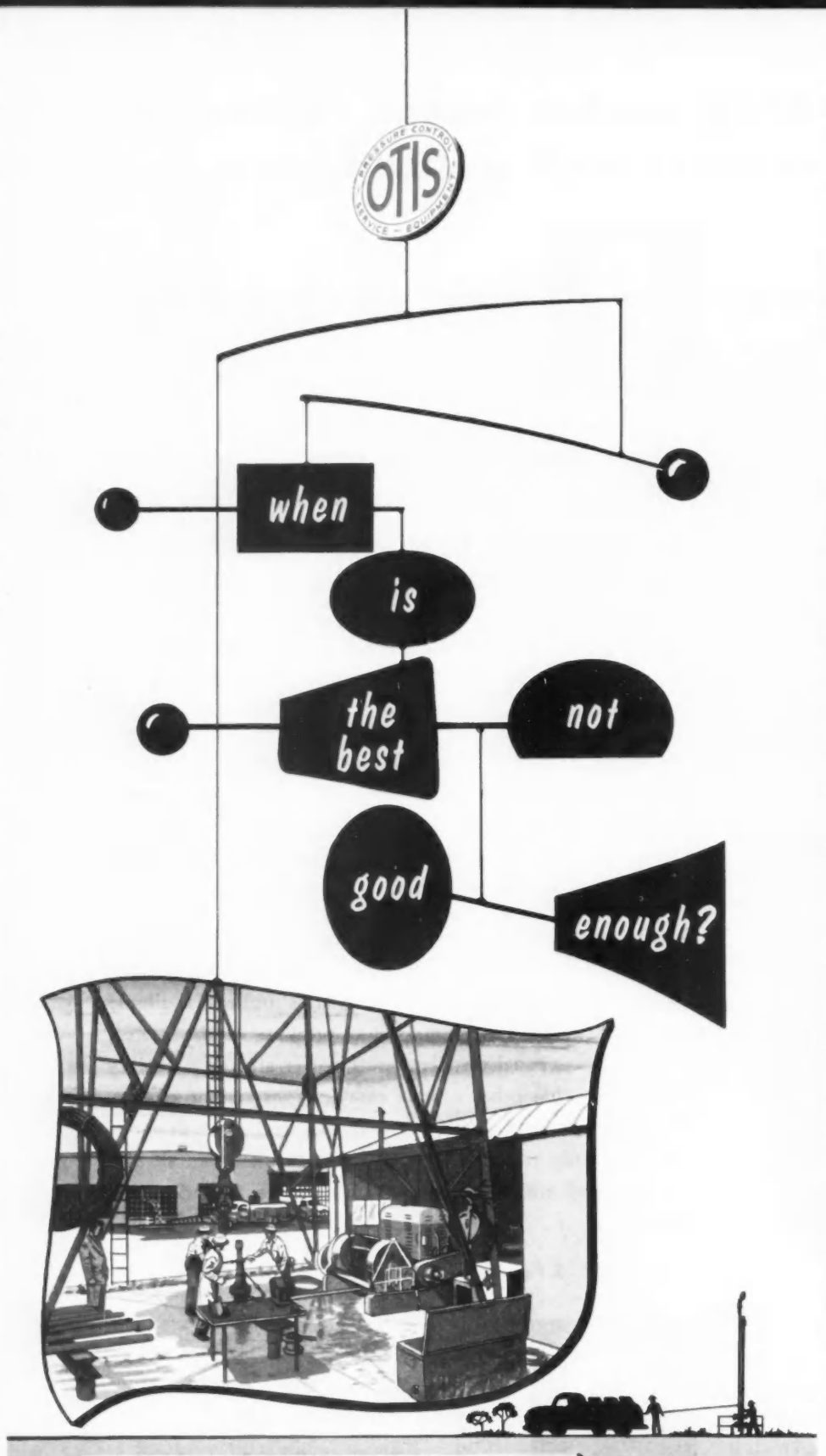

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copper tracer in these wells coincided with the appearance of the second wave of iodide tracer suggesting that water had moved from both wells 1 and 2 at this time.

Analytical Methods. Both test procedures were designed for field use, although all tests were conducted in the laboratory.

The copper test depended upon the formation of a yellow copper complex with dithizone reagent.[3] The dithizone reagent consisted of a 0.1 percent solution of dithizone in carbon tetrachloride. Two or three drops of dithizone reagent solution were added to approximately one cubic centimeter of filtered water sample and shaken. The dithizone reagent changed from green to yellow in the presence of trace quantities of copper.

The iodide determination was based upon a method of electrolytic oxidation of iodide to free iodine in the presence of starch indicator followed by additional electrolytic oxidation until the free iodine disappeared as indicated by the disappearance of the blue starch-iodine color. The quantity of iodide was determined by measurement of the time required from the start of electrolysis to the disappearance of the blue color.

Apparatus used in the iodide determination consisted of a white spot plate and an electrolysis unit consisting of two platinum electrodes in series with an 0-1 milliammeter, a switch, an 0-5000 ohm adjustable resistance, and a three-volt dry battery. Each of the platinum electrodes had a total surface area of 0.6 to 0.8 square centimeters.

Electrolysis of the water to be tested was effected by placing 1.5 cubic centimeters of the water sample in each of two adjacent depressions of the spot plate. Three drops of starch indicator solution were added to the contents of each depression. A one-half by one-quarter inch strip of filter paper was used as a bridge between the sample in the adjacent depressions. The cathode was placed in one of the depressions and allowed to remain stationary during the anaysis. The anode was used as a stirrer in the other depression during electrolysis, maintaining a fairly uniform stirring motion.

A stop watch or electric timer was

Continued on Page 209

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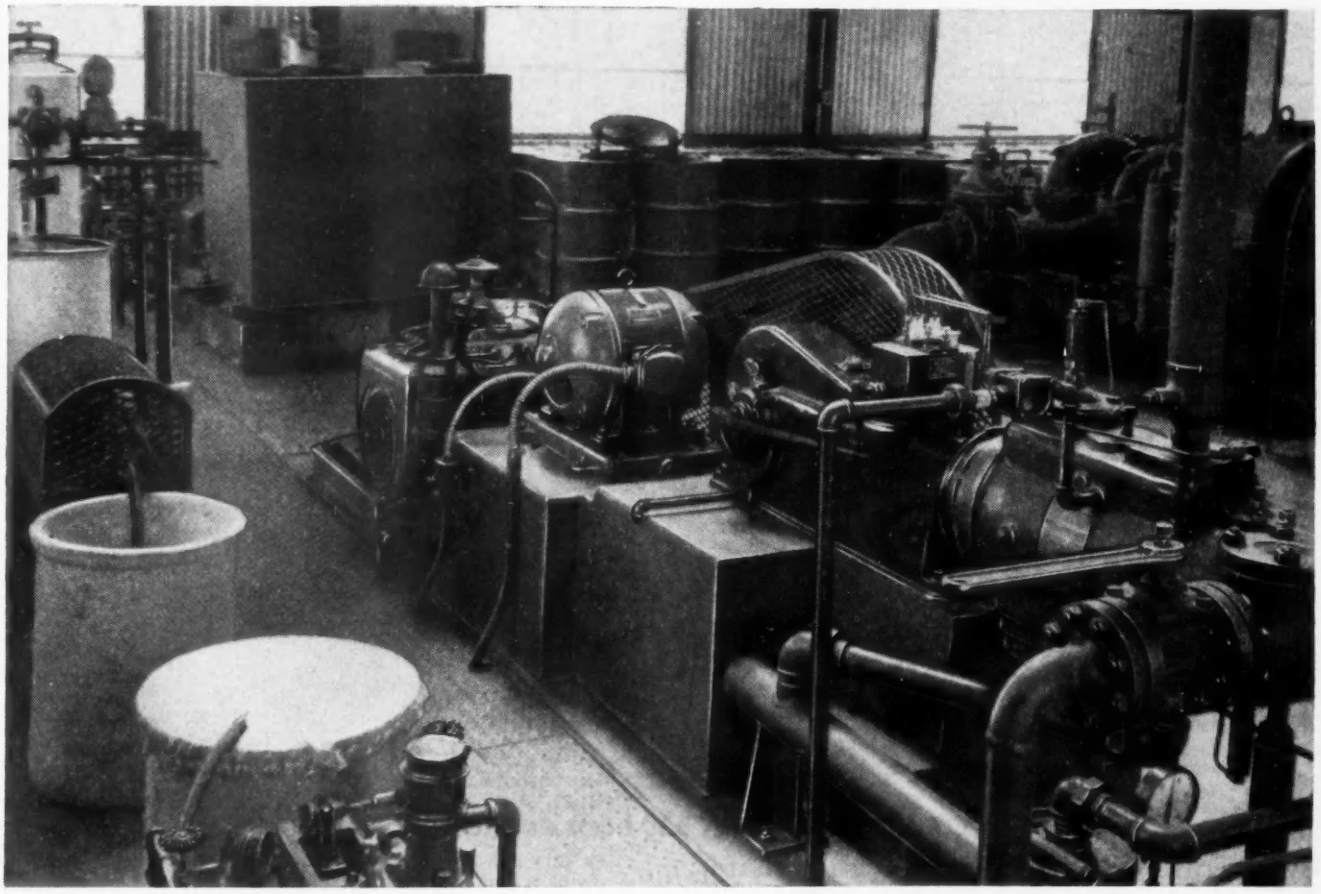

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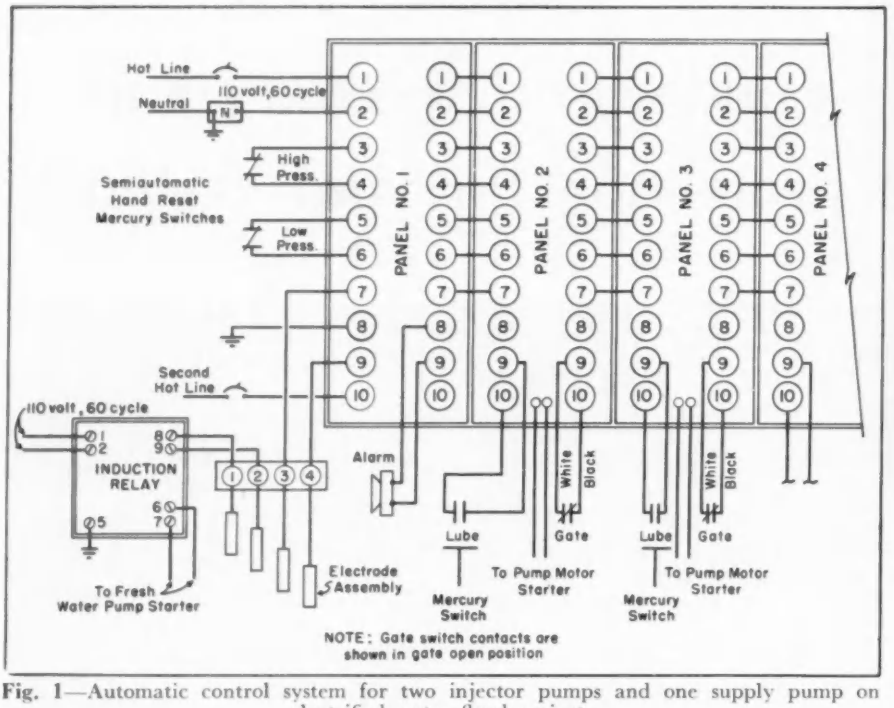

Fig. 1—Automatic control system for two injector pumps and one supply pump on electrified water flood-project.

Fig. 2—Master control box connecting all controls common to the plant.

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Fig. 3—Pump unit control panel. One required for each pump. Pilot lights at top will flash to indicate trouble in system.

By ANTHONY GIBBON, WORLD OIL Staff

FOLLOWING A STUDY of various automatic control systems for electrified water-flood operations, several major oil companies in the Mid-Continent area, collaborating with electrical engineers, devised and recently placed in operation, a standard automatic control system which features greater operating safety, flexibility and convenience. The new system is designed to:

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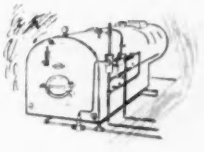

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How the control panel works . . .

tional injection pumps can be hooked up to the automatic control system with a minimum of new equipment.

After experimenting with various types of automatic control systems, operators found that servicing the controls could be quite an item. This was especially so when controls were located in areas where competent electricians were not readily available. In addition, non-standardized control systems were not flexible in that many spare control parts were not always available on short notice in the event of an emergency. They also found that when additional injection pumps were added, it was necessary to change much of the existing wiring so that the new pumps could be served automatically.

By adopting the new standard automatic control system operators can obtain spare parts at short notice, thus minimizing their maintenance problems.

Figure 1 is a schematic diagram of the control panel on the new automatic control system for one supply well and two injection wells. If additional supply wells are used it is only necessary to supply one induction relay and two electrodes for each new well added to the system. The induction relay is a probe type control and actually utilizes the supply water to complete an electrical circuit.

The high and low discharge pressure, and low level control of the fresh water supply, are connected to panel No. 1 as shown in Figure 1, and are common to all injection pumps. Each injection pump must be connected to panel No. 2 (Figure 1). When additional injector pumps are added, it is only necessary to install a low lubrication oil pressure control, gate switch, and another control panel. This unit is connected to the preceding one with seven wires and requires no change of existing controls or wiring.

Panel No. 1 is equipped with four pilot lights denoting low-discharge pressure, high-discharge pressure, low water, and low-discharge pressure short, as well as one power switch and a low-discharge pressure short switch. This last switch enables the operator to short out the low-discharge pressure control when starting the flood. After the project has been running long enough to build up pressure, the pilot light goes out and the switch can then be turned to the OFF position.

A second hot wire "feeds" panel No. 1, as it is possible to develop a short in the wiring or controls, knocking out the main breaker and preventing an alarm signal. The second hot wire is interlocked so that if the main breaker is knocked out, the alarm will still function.

Two electrodes are connected to panel No. 1, to provide a differential of the liquid level in the supply tank. If only one electrode was used the injector pumps would start and stop frequently whenever the water level reached the bottom of the electrode.

Panels 2, 3, 4, etc., are provided with two signal lights indicating low lubricating oil pressure and improper manifolding and a power switch.

The control system is so designed that if trouble develops with an injector pump, that pump is automatically stopped and a signal light indicates the trouble. Meanwhile, other pumps in the system are not affected but continue to operate. If the trouble is in any control common to all injector pumps, the entire system is shut down automatically and the trouble indicated by the panel signal light.

The automatic system is set up so that the entire water-flood project starts up automatically when power has been restored after a power failure. All pumps are set to start at one-minute intervals. If, for some reason, one pump fails to start, it is bypassed automatically. Any injector pump can be stopped by throwing the power switch on the control panel used for that particular pump, to the OFF position. If the control panel fails, it can be removed from its housing and by putting one jumper across the No. 3 terminals the balance of the injector pumps can still operate automatically. It also is possible to remove any external control for servicing by shorting or open-circuiting the leads, depending on the control taken out of service.

—The End.

New Water-flood Tracers

Continued from Page 204

started to mark the beginning of electrolysis and the current was adjusted to 0.5 milliampere as rapidly as possible after starting electrolysis. A stop watch or timer was stopped at the instant that it was judged the blue starch-iodine color had completely disappeared from the anode compartment.

Reference of the time elapsing from the beginning of electrolysis to the disappearance of the blue color was made to a previously prepared calibration curve drawn from data prepared by similar electrolysis of samples of flood water to which known amounts of sodium iodide had been added. The calibration curve drawn from these tests of the water containing known amounts of added iodine is shown in Figure 3.

It should be remarked that the slope of the calibration curve will not necessarily be the same for different waters. The amount of reducing agents present will materially alter the position of the calibration curve as well as the slope of the curve. The subject water contained no detectable hydrogen sulfide. In the presence of hydrogen sulfide, it is anticipated that the method would be inoperable for quantitative determinations although removal of hydrogen sulfide by boiling might make the method usable. Repeated tests of the flood water used showed no more than 10 percent variation from the calibration curve shown.

The iodide tracer should be useful in certain specific operations where the iodide content of the flooding water and the iodide content of the indigenous formation water are sufficiently low as to make the use of the relatively expensive iodide tracer feasible. Iodide tracer should be considered as a possible useful tracer technique to be added to what is hoped to be a growing list of such tracers available as engineering tools.

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[1] Carpenter, P. G., Morgan, T. D., and Parsons, E. D., "Use of Boron Compounds as Water Flood Tracers," *Producers Monthly*, 16, No. 12, 12 (October, 1952).

[2] Sturm, P. W., and Johnson, W. E., "Field Experiments with Chemical Tracers in Flood Waters," *Producers Monthly*, 15, No. 2, 11 (December, 1950).

[3] Feigl, Fritz, *Qualitative Analysis by Spot Tests*, Nordemann Publishing Company, Inc., 1937, p. 48.

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Nipple on Flow Line Detects Water

The addition of an inverted swedge nipple to the flow line of a new high-pressure flowing well enables the pumper to check periodically for the first trace of produced water.

Add a tee to the two-inch flow line just downstream of the flow line choke on the tree. Connect a two-inch by three-quarter-inch swedge nipple to the tee, and add a valve to the small end of the swedge as shown.

As fluids flow past the inverted swedge nipple, some of the base sediment and water is caught in it. By frequent checking soon after the well is placed on production, the pumper is given advanced warning of water production so that provisions for handling the water may be made.

Tarp Used as a Temporary Shelter

Some of the uncomfortable features connected with running back-pressure test on gas wells during bad weather can be eased by the use of a tarpaulin. Since the back-pressure test may last for some time, it is desirable not only to gain protection for the individual making the test, but to prevent the wind from distorting or interfering with accurate readings on the dead weight pressure tester.

The tarp is tied at one end to the top of the christmas tree and to the tail gate of a pickup truck at the other end. Either a light cable or rope is strung from the tree to the other end of the tail gate to provide support for a roof, thereby forming a shelter.

Mixing Drum Simplifies Treating Mud

When wells must be worked over and require a drilling mud, it is necessary to control the characteristics of the mud by use of chemical additives. Since the mud system of a workover rig is usually small, it is no chore to add the chemical additives by means of a mixing barrel placed over the mud return ditch.

This mixing drum is a regular 52-gallon steel drum to the side of which (and near bottom) has been added a small globe valve as shown. The lid has been completely removed and a paddle arrangement added inside. A three-fourth-inch coupling is tacked welded to the center of the inside bottom. This coupling serves as a bearing and centralizer for a vertical rod which is supported at the top of the drum by a tee-frame. The rod is bent into a crank handle so it can be rotated by hand. To the bottom of this rod is welded a thin gauge steel paddle used to mix up dry chemicals with water. The paddle is useful to periodically stir up the mixture so that it has uniform consistency. The globe valve can be adjusted to add just the right amount of chemicals to maintain the desired characteristics of the drilling fluid.

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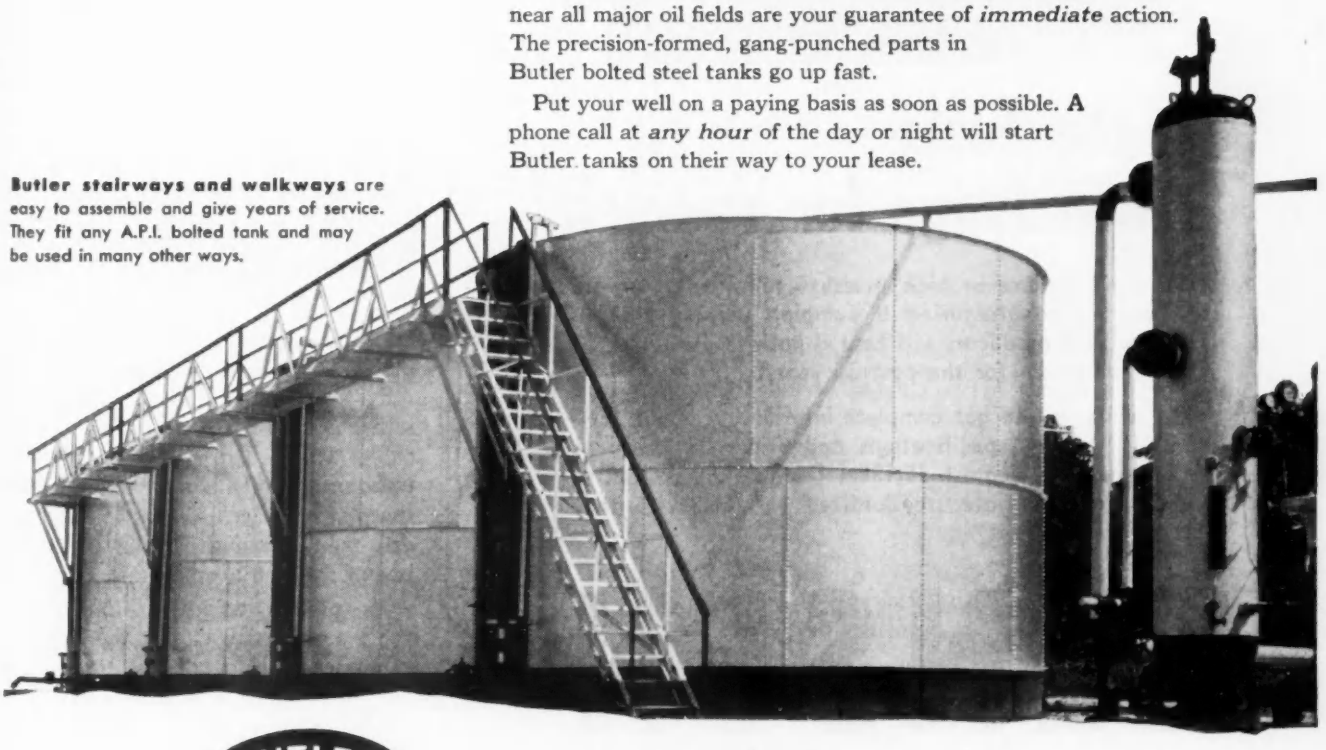

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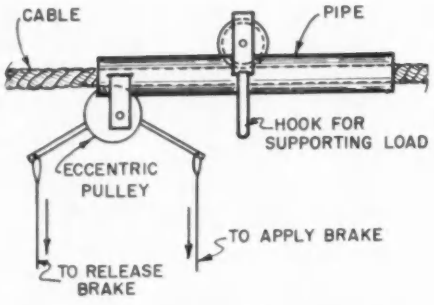
Unique Trolley Brake On Offshore Platform

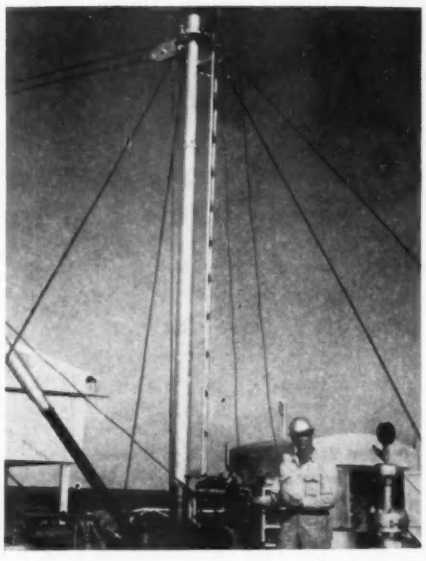
A simple but effective brake was added to an overhead trolley which served to lift lubricators, etc., onto multiple wells located on an offshore production platform. Because of economics, it is essential that several directional wells be drilled from each platform located in the Gulf of Mexico. These wells are usually in line, numbering from three to as many as six wells per line, with two lines of wells per platform, making a total of 12 wells on a large platform.



To service these wells, such as running bottom-hole temperature and pressure bombs, paraffin scrapers, etc., a lubricator must be installed on the christmas tree. To facilitate lifting the long lubricator onto the wellhead, an overhead trolley was installed. This trolley was supported by a steel cable fastened at one end to the top of the boom crane upright, and to a rigid leg at the other end of the platform.

The trolley consists of a 28-inch section of two-inch pipe to which has been added a sheave turned upside down and imbeded into the pipe as shown. The sheave rolls on the steel cable to facilitate its movement and to minimize wear. The bail on this sheave hangs downward to form a hook for supporting the loads of the lubricator.

To hold this trolley at one position once it is aligned over the wellhead, an eccentric type brake is incorporated in one end of the two-inch pipe section. The brake consists of a sheave supported from the two-inch pipe by two pieces of strap steel. A hole bored off center in the sheave and affixed to the strap steel supports make it serve as an eccentric. Two rods are welded to the sheave as indicated, and a long loop of small cable attached to these rods. The bottom loop of the cable extends near the platform deck so that an operator can manipulate the trolley over any one of the well heads.



By pulling downward on one of the manipulating cables, the operator can release the trolley so that it can be positioned anywhere along the trolley cable. By pulling down on the other cable, the eccentric wedges the cable inside the two-inch pipe and holds the trolley in a fixed position over the desired well, or out of the way next to one of the supporting uprights at each end of the platform.

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Convenient Tool Rack Added to Pulling Unit

A vertical section of two-inch pipe and short piece of strap steel was all that was needed to add a convenient tool rack to the business end of this pulling unit. The two-inch pipe was welded from the frame of the unit up to one of the angle braces as shown. The strap steel held the top of the two-inch pipe in position and also served to support turn buckles and load binders.

This vertical section of two-inch pipe is a convenient rack on which to nestle elevators of varying size. Being at the rear of the unit, it is no trouble to change elevators when needed, and the ones not in use may be racked and kept out of the way. A load binder may be seen barely extending from the top of the vertical pipe rack, for the handle is inside the pipe. A piece of two-inch pipe welded to the edge of the horizontal truck bed forms a bin into which short nipples, collars, etc., may be carried from job to job.

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This all-around pump is particularly efficient in abrasive, sandy, or dirty fluids, and in wells with unusually high bottom-hole temperatures which cause unequal expansion of metal plungers and barrel tubes with critical fits.
The "fluid seal" principle in the design offers a number of advantages over conventional rod pumps: The free-falling plunger and small bore subject the rods to less stretch and strain . . allow pumping at a greater strokes-per-minute rate; plunger friction and working parts wear are negligible. The valves are fitted with standard A.P.I. size balls and seats; no special sizes are needed. A no-go ring on the standing valve seals off the seating area immediately above the hold-down, an important feature for sandy wells.
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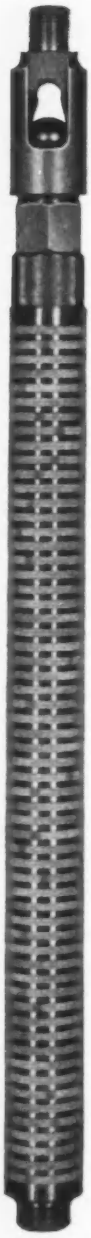
Lifting Bails Speed Up Pump Moves

Mount a small portable electric-driven transfer pump on a skid base which incorporates lifting bails at each end of the unit. The lift bails make it easy for two men to move the pump quickly from one location to another, or to load and unload it from a truck bed.

This is a small-capacity gear pump driven by a one-horsepower electric motor. Only the motor and pump are mounted on the simple channel-iron skid. Unions on the suction and discharge of the pump enable the roustabout crews to disconnect and install the unit quickly. The lifting bails are made of five-eighths-inch sucker rod material bent to the desired shape and welded to the ends of the channel iron skid. This portable electric-driven pump is used around the lease for transferring oil from one tank to another, or for rolling a tank when treating it with chemicals.



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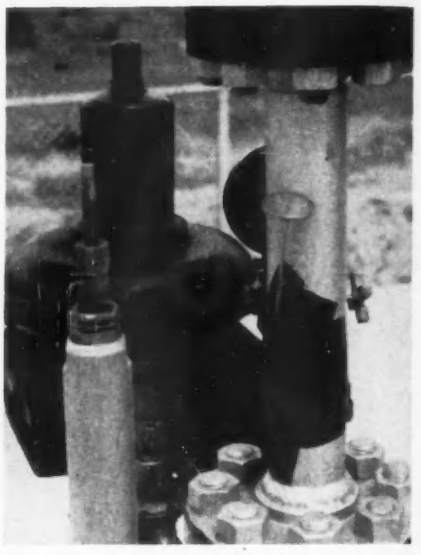
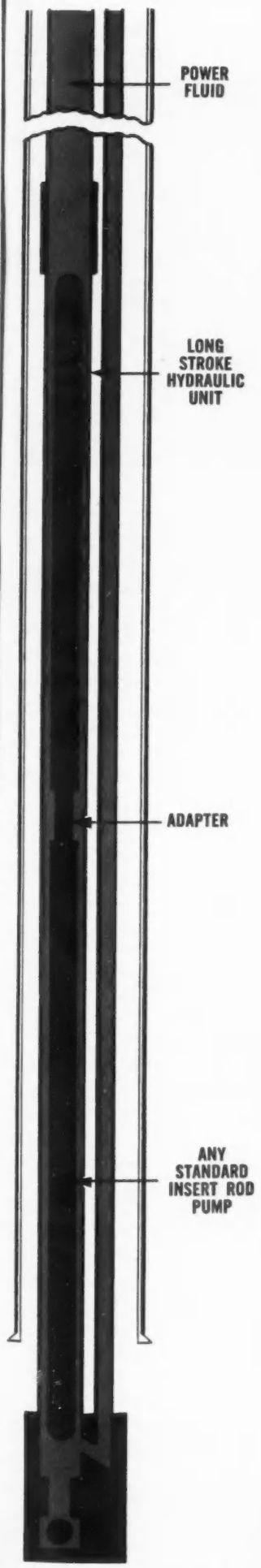


Thermometer Taped on Flow Line a Fast Check

As a temporary method of approximating flowing gas temperature on an extremely high-pressure well, a dial-type thermometer may be taped to the flow line as shown. Location of this point may be just downstream of the adjustable flow bean or other points where approximate temperatures are desired.

This dial-type thermometer is laid against the flow line (in this case just below the adjustable choke) and taped with several rounds of a plastic type tape used to coat flow lines for protection against corrosion. The indicated temperature will be somewhat lower (if gas stream is hotter than ambient temperature) and higher (if gas stream is colder than ambient temperature) because of the insulated effect of the pipe wall. However, where a quick approximation is needed, this method will do the job.



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Improved design and longer operating life *lower* the cost of labor per barrel, *lower* the cost of maintenance per barrel, *lower* the investment cost per barrel, *lower* the cost of fluid per barrel.

Also the ability of Reda pumps to produce greater volumes in limited casing sizes and from greater depths often reduces the number of source water wells required.

Reda engineers have long been associated with water flooding operations and are fully qualified to assist operators in discussing their source water requirements.

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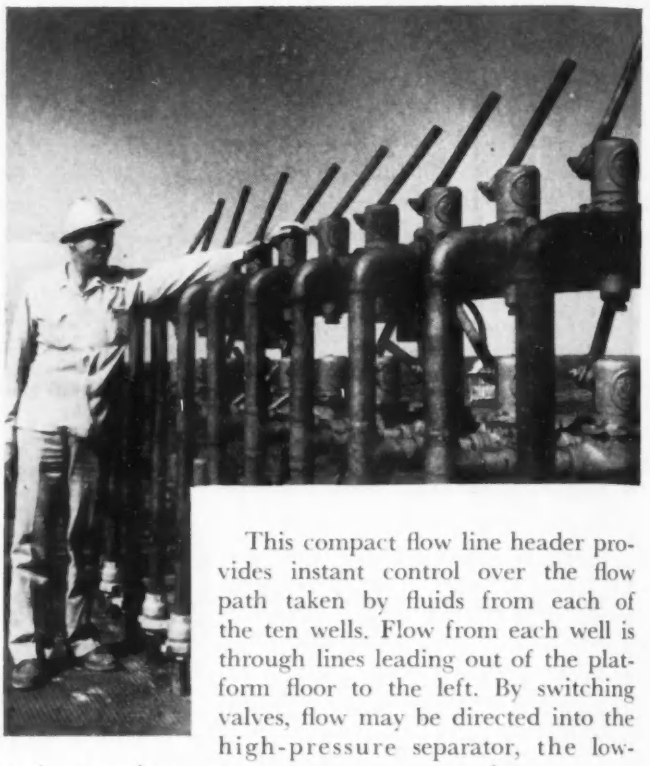
This Compact Header Has 3-Way Flow



Variations in producing conditions in an offshore field have resulted in this compact three-way flow header. One platform in this field contains ten wells, some producing from different horizons than others. Result is that flowing pressures vary widely. Some wells are high-pressure wells, while others may be classed as much lower pressure producers.

For the high-pressure wells, a two-stage separation is provided. Flow is first into a high-pressure separator, which dumps into a low-pressure separator. The low-pressure wells produce directly into the low-pressure separators.

This compact flow line header provides instant control over the flow path taken by fluids from each of the ten wells. Flow from each well is through lines leading out of the platform floor to the left. By switching valves, flow may be directed into the high-pressure separator, the low-pressure separator, or the test separator unit. All connections are welded, and the complete assembly is at a convenient height for quick operation.

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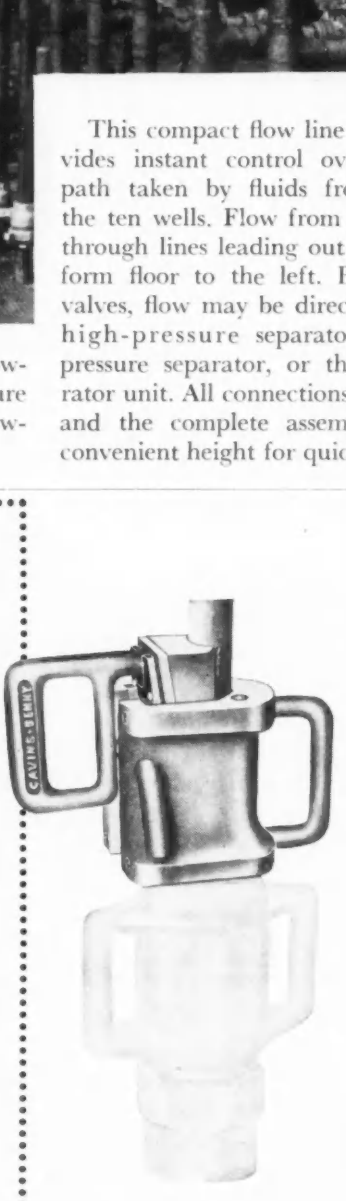

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Private Enterprise Scores Again

French oil hopes buoyed by discovery of Europe's No. 1 producer.

By DON KLIEWER and ROBERT E. SPANN,
WORLD OIL Staff

THE FIRST oil exploration concession ever granted by the French government to a foreign private capital entity has paid off with the largest producing well in Europe.

Esso Standard's S. A. F.'s Parentis 1 in southwest France, brought in during April, has a settled flow of 1100 barrels of 33.5 gravity oil a day on quarter-inch choke and is a major discovery in every sense of the word.

The well, which is continuing testing, is situated in a wildcat area about 70 miles northwest of the Lacq field in the Aquitaine basin, 45 miles southwest of Bordeaux (see map) and about 10 miles inland from the coast. It is in a flat, forested area with prominent sand dunes and near a series of coastal lake resorts.

Completed at 7866.75 feet, Parentis 1 is still testing at a rate of 1200 barrels a day on quarter-inch choke, 2600 barrels on three-eighths-inch choke, and 3800 barrels daily on half-inch choke.

Five and a half-inch casing was set at 7340.6 feet. The pay section starts at that depth and continues for 526.1 feet to bottom of hole. The section is limestone, and estimates are that about half the pay section is porous.

Politically, this discovery may mark the real beginning of foreign private capital into French oil production operations. The 4.3 million-acre con-

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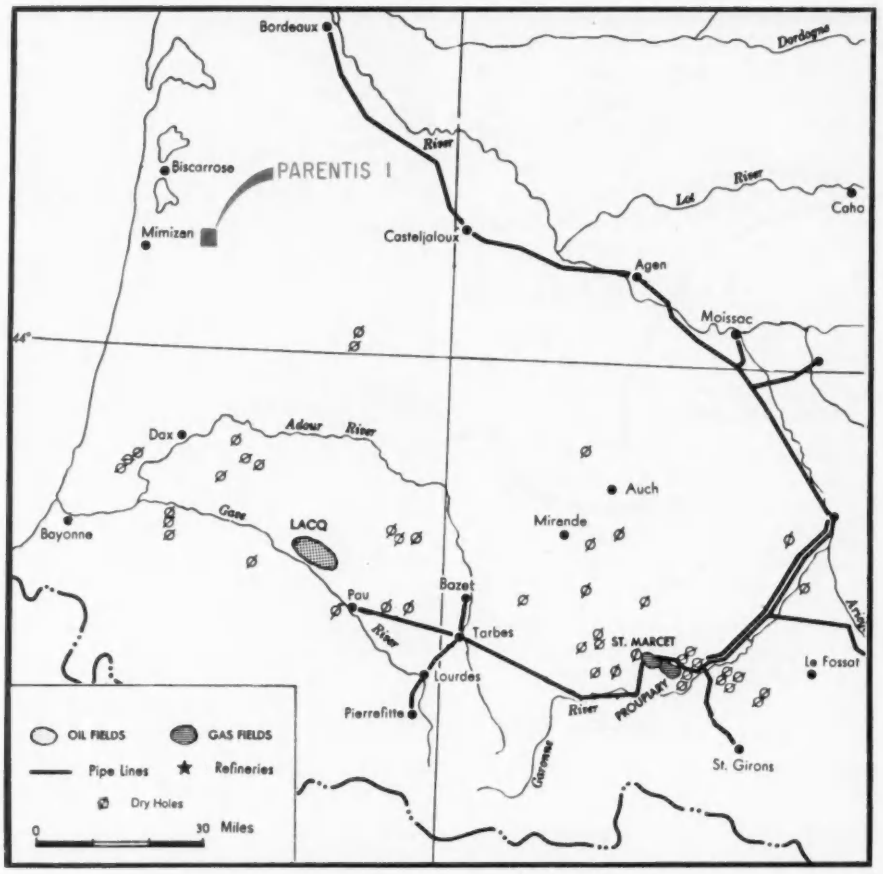
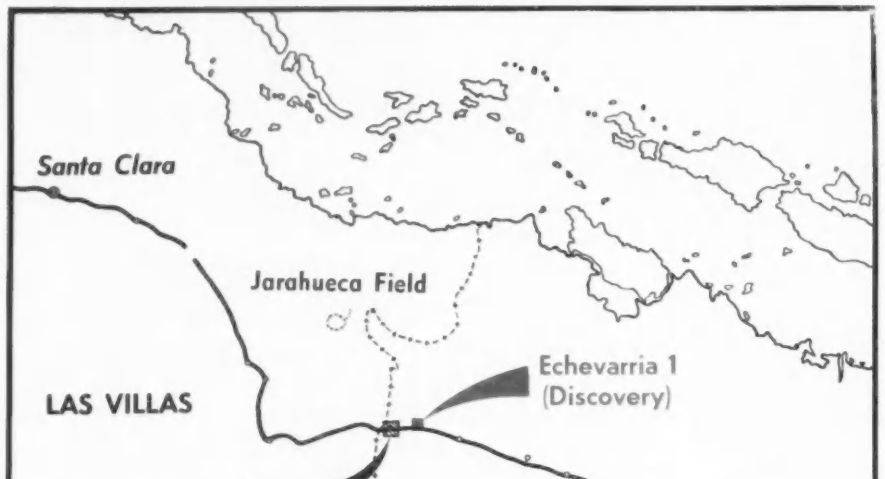


Discovery well data . . .

Production	**1100 barrels daily**
Gas/oil ratio	**Very low, running 20-35 cubic feet per barrel**
Bottom-hole pressure	**3240 pounds per square inch**
Geologic age of producing horizon	**Lower Cretaceous**
Pipe, completion practices	**5½-inch casing set at 7340.6 feet without liner (Liner unnecessary due to firm limestone formation)**
Drilling problems	**None—routine completion**
Type of rig	**Diesel rig composed of American, French and German components; drawworks — American; engine — French**
Contractor	**Forex, a French company**
Crude purchaser	**Unknown; however Esso refinery is located at Port Jerome, several hundred miles up the coast**
Pipe line facilities	**None existing; plans not made**
Nearest production	**Lacq field, about 70 miles southwest**
Number of days required	**Not presently known since drilling was halted several times while awaiting equipment**



Cuban Wish Comes True

The 'Pearl of the Antilles' faces an optimistic oil future as national company and Kerr-McGee bring in a major discovery.

By ANTHONY GIBBON, WORLD OIL Staff

A DREAM which has tantalized oil men and Cuban industrialists for decades became a reality on May 2, 1954.

On that date a group of Cuban businessmen who had been assisted in their efforts by American drillers and technologists, reported to their government and to the world: "We have successfully completed the Echevarria 1 as an oil well. It is flowing at the rate of five barrels of oil per hour from a sand at 1072 to 1088 feet."

The report heralded the first major oil strike for Cuba.

Oil in small quantities has been produced on the island for many years. But the Echevarria 1, in a sugar cane field about 220 air miles southeast of Havana and almost in the geographical center of the "Pearl of the Antilles," rates with oil discoveries of the first order.

Reports indicate that the well, which at one time was about to be abandoned, is producing from a siliceous detritus of probable Cretaceous age. While only 16 feet have been perforated, operators estimate the productive interval at between 40 and 50 feet. Additional zones down to 2000 feet have had excellent shows.

Of greater significance is the areal extent of the region where the strike has been made. It opens a great untested sedimentary basin which extends from the center of Cuba southward to its outermost keys, with thousands of feet of potentially productive reservoir and source beds within reach of the drill.

Seldom has the discovery of oil aroused such widespread interest in this country. Within days of the announcement representatives of major and independent oil companies, as well as individuals, flocked to the island. Nothing has developed yet to dampen the enthusiasm of those who have visited the scene. Those who have checked believe now that a new basin area is on the verge of becoming an important oil-producing province. Its implications to the economy of Cuba are tremendous, since Cuba has always depended upon two major crops for its economic existence—sugar cane and tobacco.

U. S. Watches. To the U. S. the strike may have an important bearing on the defense plans. Only 90 air miles separate Cuba from Key West, Fla. And this strip of water can easily be controlled and defended in time of war.

To Cubans, the discovery of oil presages an era of industrial expansion by providing an element which, until now, has been lacking in the island's economic setup. Cuba has had to spend some $35 million a year for imported refined products. Cuba lacks coal and other natural fuels. Its sugar mills burn bagasse, a cane by-product which can be processed into pulp once the mill furnaces are fired with cheap fuel oil. This is but one of the immediate advantages that substantial oil production on the island will provide.

Americans may take justifiable pride for their part in this venture. Last March WORLD OIL[1] in an article describing the initial operation resulting in this important Cuban oil discovery declared: "The Point-4 program of rendering technical assistance to friendly nations has been translated into action . . ." It referred to the contract whereby Kerr-McGee Oil Industries, Inc., of Oklahoma City, cooperating with a group of Cuban industrialists, agreed to furnish experienced drillers and crewmen as well as technical know-how in the drilling of the Echevarria 1.

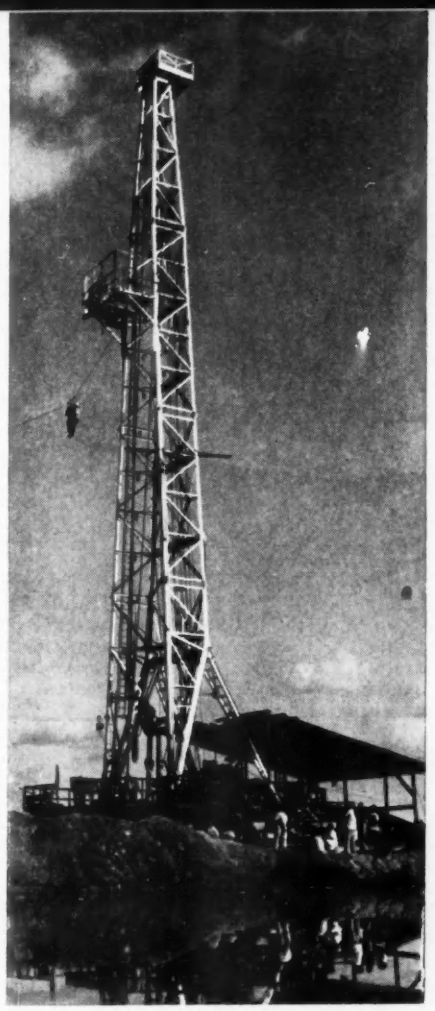
American technological knowhow and complete cooperation and understanding between all those associated in the venture has paid off handsomely. Seldom has an oil development program with such important international implications started off on such a note of good will and cor-

diality. None can point an accusing finger at the Americans who participated in the venture and raise the cry of "Yankee exploitation," an accusation which has done so much in the past to create bitterness and misunderstanding between this nation and its Latin-American neighbors.

Echevarria 1 is situated on the Dos Estrella concession comprising 27,774 acres, adjacent to and east of the town of Jatibonico in Camagüey Province. It is on the west limb of the Jatibonico-Ciego de Avila-Zaza Basin, to the east of the Trinidad mountains, and west of the Camagüey Uplift.

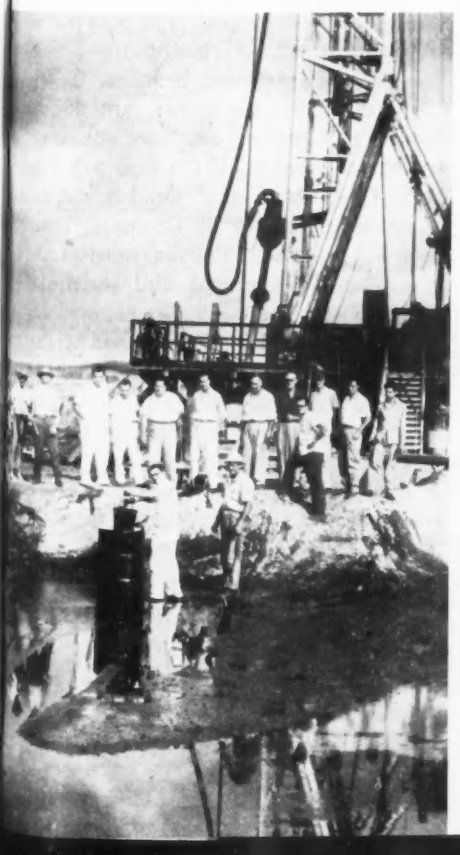
Jarahueca oil field is about 25 miles north and west of the discovery, in Las Villas Province. This has been the most prolific oil producing area in Cuba and produces from zones at from 1200 to 2800 feet. Other Cuban oil producing areas include the Motembo and Bacuranao fields, both in Las Villas province. Both are today practically non-productive.[2]

Jarahueca Group. The concession is controlled by Cuban businessmen known as the "Grupo Jarahueca-Motembo" or "Jarahueca Group." Dr. Antonio Iglesias, prominent Havana lawyer and a firm believer in the oil possibilities of his country, is one of the principal representatives. Others involved are the Refineria Cabaiguan, S.A., Sixto Mesa, president, and Petroleo Jarahueca, S.A., Carlos Garcia Rodriguez, vice president and acting president. Señor Mesa is president of the Jarahueca Group.



THIS RIG, at site of Echevarria 1, drilled a producing well its first time in use.

CREW AND MEMBERS of Cuban syndicate which financed and drilled Echevarria 1, watch as Dr. Antonio Iglesias of Havana, principal representative of Grupo Jarahueca-Motembo, stands beside barrel gauging oil flow.



Jarahueca Group has engaged in the oil business in Cuba for several years and owns production at Jarahueca and Motembo.

The Cuban government, with the full blessing of President Fulgencio Batista, should be highly commended for assisting its own people in their search for larger quantities of cheaper fuel. Purchase of a drilling rig was made by the government. This was then made available to the Jarahueca Group on very reasonable terms, which permitted them to proceed to explore areas of promise.

The rig which drilled the Echevarria well has a capacity of 10,000 feet. It is equipped with a jackknife mast, three diesel-powered motors, about 10,000 feet of 4½-inch drill stem, and its own cementing equipment.

Kerr-McGee contracted with the Jarahueca Group on a cost plus a "beneficial interest" basis. That is, Kerr-McGee retained an option to buy into the property. The enthusiasm and apparent knowledge of the oil business shown by the Cubans, and their desire to develop commercial oil for their country, were the factors that prompted Dean A. McGee, president of the Oklahoma City firm, to cooperate with them and enter into the Point-4 type contract.

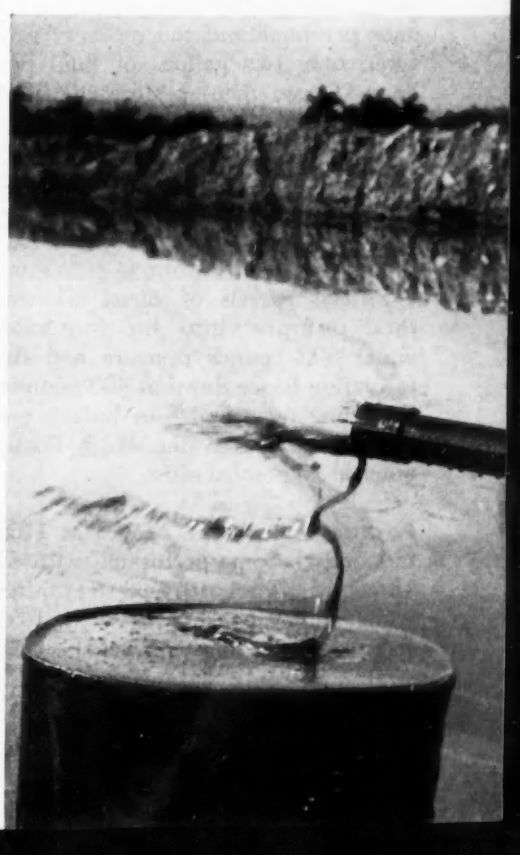
Terms of the contract were discussed and agreed to in Oklahoma City last fall. Previously, C. R. Clark, research geologist for Kerr-McGee, had gone to Cuba to make a geological reconnaissance of the prospect.

Following the reconnaissance, Kerr-McGee sent a drilling engineer and crew to move the rig, which was stacked in a Havana storage yard, and begin actual drilling operations.

Echevarria 1 was spudded December 27, 1953, and total depth of 8375 feet was reached March 29, 1954, a total of 92 days. A total of 67 bits were used including two 12¼-inch; one 17-inch; 62 8⅝-inch and two 5½-inch core bits. The 8⅝-inch were hard formation rock bits and some were full gauge core cutters. No unusual drilling problems were reported.

Crews started with fresh water gel mud at 106 feet and the hole was drilled with fresh water gel mud

ECHEVARRIA 1 flows oil and gas into pit. The well, in a sugar cane field about 220 miles southeast of Havana, is producing about 200 barrels of 15-gravity crude daily through choke.



chemically treated maintaining a mud weight of about 9.8 lbs. and viscosity of 40.

Pilot hole was drilled to 891 feet and on January 9, after reaming to 256 feet, 13⅜-inch casing was set and cemented with 225 sacks of cement. On February 6, the hole was drill stem tested at 4097-4143 feet with negative results. Two days later another unsuccessful drill stem test was made at 4267-4315 feet. On April 9 the well was surveyed to total depth.

Seven-inch outside diameter, 26-pound extreme line, N-80 casing was run and cemented at 1855 feet (TRB) measurement, with 500 sacks of cement on April 14.

On April 22, casing was jet perforated at 1630-1642 feet with four shots per foot. Packer was set at 1619 feet. Mud was displaced with water in the 2⅞-inch tubing and casing and packer set.

On April 23, swabbing was commenced and in about 24 hours the well produced about 150 feet of salt water fillup in the tubing per hour. Tubing was pulled and the zone at 1633-39 feet perforated with 24 shots with the same swabbing results.

Retainer was set at 1350 feet and the 1304-12-foot zone was jet perforated with four shots per foot. Packer was set at 1299 feet and crew swabbed about two gallons of oil per hour. Packer was reset at 1299 feet and the interval between 1308-16 feet was reperforated with 30 shots. The seven-inch casing was then bailed once per hour and the recovery was again only two gallons of fluid per hour. Crew then perforated from 1304-12 feet with 30 shots, set packer and tubing and on swab recovered small amounts of oil. Further swabbing recovered one gallon of fluid per hour and this was half oil and half mud.

Fifteen barrels of diesel oil was then pumped into the formation under 800 pounds pressure and the formation broke down at 400 pounds. Swabbing recovered four barrels per hour of oil and water which finally reached 50 percent oil.

Packer was set on May 3 at 1160 feet and the pipe perforated with 64 shots between 1072-88 feet after which tubing packer was set at 1055 feet. After washing with diesel oil the swab was run one time at 400 feet and the well started flowing muddy oil at the rate of five barrels per hour through ⅝-inch choke. Quite a bit of gas accompanied the oil flow. The well soon cleaned of mud and water and flowed clean oil at the above rate.

DR. ANTONIO IGLESIAS, principal representative of Grupo Jarahueca-Motembo, Havana, Cuba, a group of Cuban industrialists and oil men, which with assistance from Kerr-McGee Oil Industries, Inc., and the support of the Cuban government, recently completed Echevarria 1, first major oil strike in Cuba.

Oil is 15 gravity, brownish in color with good body but apparently low gasoline content as it would not burn by normal lighting procedures.

From the surface downward the following zones appear to warrant further testing:

A—1072-1130 feet (production now coming through 64 perforations tions 1072-1088 feet)
B—1302-1320 feet
C—1630-1642 feet
D—1840-2000 feet (Testing of this zone was recommended as a last resort).

The following surveys were run:

- Electric log.
- Microlog.
- Hole caliper or section gauge.
- Dipmeter.
- Temperature.

Among others, some credit for successful completion of Echevarria 1 goes to Dr. Robert G. Hamilton of Tulsa, recognized authority in well log interpretation, who was called in by Dr. Iglesias.

The well was logged from top to bottom with every scientific logging tool known to the industry.

The Works. "We gave that well the works," Dr. Hamilton said. "We used seven logging devices. The logging alone cost $10,000.

"We tested a zone between 1650-80 feet and found some oil shows. A zone between 1300-10 feet yielded 50 percent oil and 50 percent mud and drill water on a swab test.

"When we perforated at 1072 feet, the well came near blowing out. Then we perforated with 64 shots between 1072-88 feet and the well came in with a bang and flowed 150 barrels in 24 hours. When put on ⅝-inch choke on tubing, it flowed 100 barrels a day and maintained the flow continuously."

Cuban oil statistics are not very accurate, but latest figures indicate the country produces less than 100,000 barrels of crude oil a year and imports approximately 50,000 barrels daily, mostly from Venezuela. Thus, if large scale oil production can be developed on the island it will free that country from dependence on its one big export crop, sugar, which accounts for an estimated 90 percent of its dollar income.

Low gravity of the oil being produced at the Echevarria 1 is the only discouraging factor in the Cuban development. However, geologists point out that the basin area where the discovery has been made will likely yield crudes in all gravity ranges.

Speedy development is anticipated on the island. It is anticipated that a pipe line will be laid from the new reserve to the Cabaiguan refinery. If necessary, new facilities will be constructed at the refinery to process the low gravity crude.

Several major American oil companies including Gulf Oil Corporation, Standard Oil Company (New Jersey), The Atlantic Refining Company, Shell Oil Company, and Deep Rock Oil Corporation have substantial concessions in Cuba and are expected to acquire additional holdings. Most of the major oil company concessions are along the northern coast of Cuba. The central and southern areas considered as having poor oil possibilities until the Echevarria strike are expected to attract other major oil companies and independent operators. All minerals in Cuba, including oil and gas, are vested in the nation and negotiations for new concessions will have to be conducted directly with the Cuban government.

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[1] 'Cuban Hopes Center on a Wildcat,' Anthony Gibbon, WORLD OIL, March, 1954.
[2] 'Cuba's Oil Outlook,' J. E. Kastrop, WORLD OIL, May, 1950.

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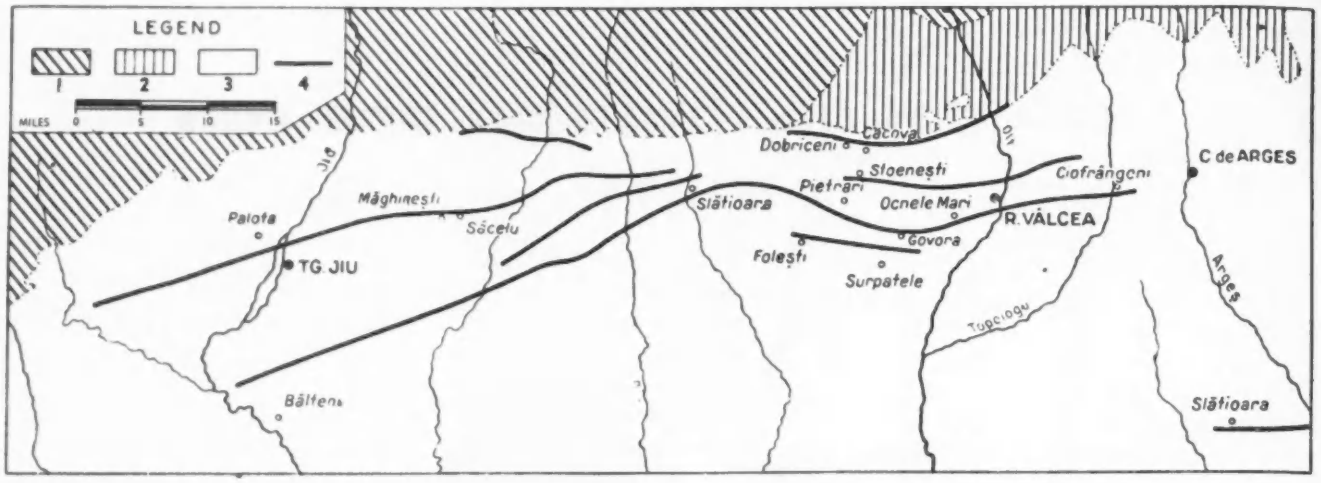


TECTONIC MAP of the northern border of the Getic Depression: 1. Crystalline-Mesozoic zone of South Carpathians; 2. Paleogene of Getic Depression; 3. Mio-Pliocene of Getic Depression; 4. Anticlinals.

Time Running Out for Roumania's Oil

Despite fantastic and impossible Russian claims, gas pressure and production are waning.

By GEORGE ROSU

IN THE REALM of Soviet percentages—concocted according to unfathomable recipes — there is little less tempting than to accept uncritically the absolute figures on industrial production levels which seldom are announced officially.

This is true of the figures on Roumanian oil production announced last August. Yet, the unusual promptness with which Roumanian officials volunteered to assess anticipatedly the 1953 and 1955 crude oil output at 69.7 million barrels and 82.5 million barrels, respectively, was of such nature as to cast doubt about the veracity of the claim.

Because the figures were announced before 30,000 western youths attending the World Youth Conference and due to the workers' riotings two months earlier, all official utterances in the Soviet world were planned to convey the impression that everything was harmony and prosperity and that the Soviet "planning" formula was infallible. Like all Soviet plans, they look good on paper but seldom reach reality.

All available facts bear out that the psychological effect carefully was calculated. Petroleum is, knowingly, a short commodity in the Soviet orbit. On the other hand, after 1947, no absolute figures have been announced officially about Roumanian oil output. Therefore, the officials presumed that, at this juncture, almost any absolute figures communicated might sound plausible to Western ears; hence, the high production levels forecast for 1953 and 1955.

Obviously, they conjectured that, in case these figures were accepted by the West, Russia's gain would be twofold:

- Dispel the current belief that liquid fuels are short in her orbit.
- Prove that Soviet management of the satellites' economies is, after all, not as unsuccessful as assumed.

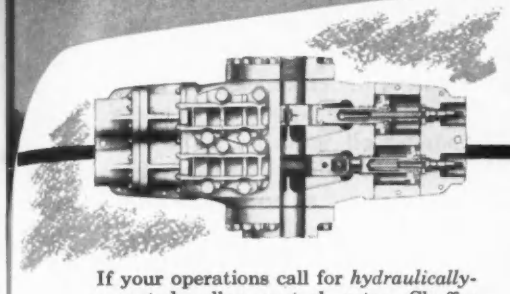
Despite this carefully created scenic environment, few Western publications accepted as truthful the high output forecasts.

There is very little reliable data available to verify or disprove Soviet percentages and absolute figures. The few reports leaking through the Iron Curtain estimate the current output at half of the official figures. Such reports are corroborated by conditions in limited sectors of observation and the utter scarcity of oil products on the domestic market. The whole truth about the Roumanian petroleum may be known, actually, only by a handful of Soviet representatives.

The mere expression of doubts and discarding of official data do not, however, promote the inquiry about the current Roumanian oil output. They help to widen the existing vacuum in which, afterwards, many an estimate may be thrown; and each one may appear acceptable, particularly when it claims to originate from "usually reliable sources," or from anonymous experts "in the know."

Another avenue of approach would be to accept all official pronouncements, as well as all information from whatever source it may come, but only as prima-facie evidence. These should be used as corroborative data in a computation based, however, upon long-range trends resulting from past evolution and the value of the geological formations. This method may be reproached as being abstract, inasmuch as it omits the unpredictable

Part 1



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If your operations call for *hydraulically*-operated cellar control gates, Shaffer Hydraulic Cellar Control Gates are—by all standards—unsurpassed in dependability, compactness and years-ahead operating features.

In addition, Shaffer Hydraulic Gates are available in both *Double* and *Single* types—whichever you prefer. Both incorporate the same advanced features, and parts are, in most cases, interchangeable between the two types, simplifying inventory and maintenance. Both types feature...

SIDE DOOR RAM CHANGES: To change rams, simply unbolt doors in the side of the Gate, change rams and bolt the doors shut again. It's by far the quickest, simplest method of changing rams—and in Double Gates, rams in the upper and lower compartments can be changed with equal simplicity. There's no need to dismantle the upper compartment to change rams in the lower compartment—or vice versa. Each compartment has its own doors—is equally accessible!

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DIRECT HYDRAULIC DRIVE: Shaffer operating cylinders are *directly behind* the rams. For maximum safety there are no secondary connections or yokes between hydraulic cylinders and rams!

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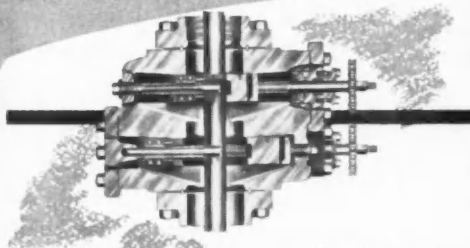

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elements which characterize the oil searching activity.

The knowledge available about the Roumanian structures is such, however, that one may discard any hypothesis or speculation about a possible rich strike nowadays. The unalterable fact is that, whatever rise in oil output has been recorded since 1947 has come only by exhausting the known deposits, and by disregarding completely all rationalization principles which underlie the Western concept of sound enterprise and profit.

Planning Initiated. Like all other activities in the Soviet orbit, Roumanian oil production was subject to planning. This started only after the wholesale nationalization (of June, 1948) was carried out.

Planning commenced with two consecutive one-year plans, applied in 1949 and 1950, and was followed by the current Five-Year Plan.

During the short-term planning, the oil industry was divided into two sectors. Sixty-eight percent of the output was supposed to come from fields managed by government holdings—"Muntenia" and "Moldova" oil centers—into which were hurriedly tossed the expropriated oil companies.

Both holdings were rather loose organizations, created on mere geographic radii, with no specific technical and administrative competence. The activity was, thus, carried on as before, e.g., limited to the individual oil fields.

Targets were 38 million barrels to be produced in 1949 and 50 million barrels in 1950. Actual output was, however, only 30 and 36 million barrels, respectively.

To reach these rather modest goals, tremendous drilling activity had to be performed. Drilling objectives were 1.5 million feet for 1949 and 2.1 million feet for 1950 (as compared with less than 1 million feet drilled in 1948).

Lack of equipment and materials and, to an even greater extent, confusion created by a rapid succession of reorganization and regrouping plans hampered fulfillment of these aims.

In retrospect, however, there is evidence that substantiates the presumption that the production and drilling targets were rather of a subsidiary nature and that the foremost aim of the "planning" has been to strengthen the Soviet tutelage over the whole Roumanian oil industry.

It is true that in the summer of 1948 Russia reduced by a fraction the tremendous war reparations she extracted from Roumania, the major part of which was paid in oil products. Yet, because of earlier "arrangements," this reduction did not benefit the oil industry in any way.

Prior to the inception of the "planning," the charter and bylaws of the Sovrompetrol company had been amended several times through a multitude of protocols; and each time its authority and scope of activity have been strengthened and widened.

Through a confidential protocol of February, 1948, the Roumanian government undertook to pay to Sovrompetrol more than 2 million dollars on free account for alleged special services rendered by this joint company. Earlier agreements secured the payment in free U. S. dollars of all future shares Russia was entitled to in the proceeds of Sovrompetrol.

In addition, provisions of the original charter authorized this company to use freely all foreign currencies earned from oil exports, i.e., without asking the authorization of, or rendering account therefor to, the Roumanian State.

The short-range planning period was thus inaugurated under Soviet monopoly. The permanent monopoly over Roumania's major source of hard currency—export of oil products—granted Russia undisputed power to decide whether the oil companies merged in the two holdings, Muntenia and Moldova, survive or perish. The hard currency monopoly permitted her to control the import and distribution of badly-needed equipment and pipe, the absence of which rendered impossible the implementation of even a modest production plan. Russia decided on the extinction of the two holdings.

This decision was officially made in August, 1949, when Sovrompetrol was granted, by a new amendment of its charter, absolute monopoly over the entire Roumanian oil industry and resources. Muntenia oil center—in which were merged the southern fields—was quietly taken over by Russia in September, 1950, while Moldova center became an exclusive Soviet stronghold even earlier.

Consequently, at the end of the short-range planning, the only positive result is the entrenchment of Sovrompetrol's monopoly over the entire Roumanian oil industry. From its inception, this joint company has been administered as an extraterritorial entity. All executive powers are vested in a Soviet general manager who owes allegiance to, and receives orders directly from, Moscow, although Roumania serves him kingly emoluments.

This joint company is not subject to laws of the country or to authority of the Planning Commission. In fact, the planning machinery is instrumental to implementing this entity's monopolistic activities, although the latter are financed mostly from Roumanian budgetary appropriations.

Five-Year Plan. It was under these conditions that the Five-Year Oil Plan was launched in January, 1951. The original version set a target of 75 million barrels for 1955. The revised version of 1952 increased it to 82.5 million barrels, and official figures issued last August aimed to convince that completion was already a certainty. However, this claim is questionable, for it contrasts not only with known facts but even with news items printed by the Roumanian press itself.

The press says the recent rise in crude output stems from developing the "huge reserves" which remained untapped by the "capitalist regime" for speculative reasons.

Yet, a careful perusal of the Roumanian press during the last three years fails to reveal one single field of major importance discovered recently that may have increased the output to such a high level. (The Bucsani discovery in 1935 remains the last major oil discovery in Roumania.) Reports published by newspapers and periodicals mention mostly known formations which are, presently, over-saturated with wells; they speak of efforts to reactivate abandoned wells, to deepen old ones and to develop marginal fields.

Another source which allegedly helped boost crude output are reactivated oil wells. Toward the end of 1947, Soviet experts completed a list of 496 wells—abandoned during the past 30 pears—that had to be recommissioned. A part of these were situated in the low-yielding Bacau region. Many of them were shut down as early as 1916-1920. Others were in the

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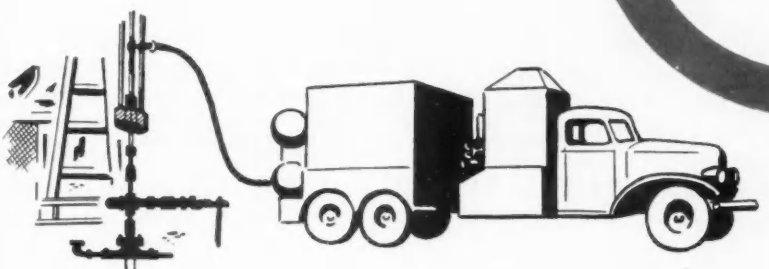

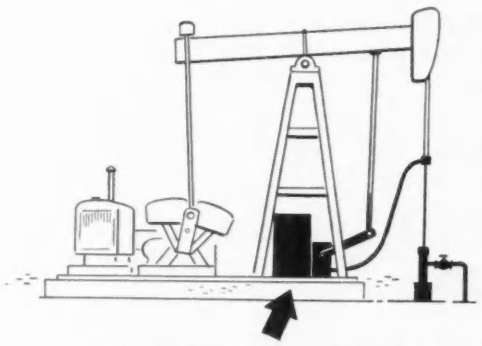

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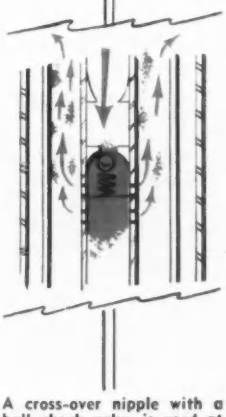

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comparatively low-producing Buzau district, and the remainder were in the richer southern fields.

The Roumanian press admitted that these wells were abandoned because of their very low yield. Customarily, in the pre-Soviet era, the bigger oil companies used to sell declining wells to smaller companies or individuals who continued to pump them until the wells were almost dry. There is, therefore, little to be expected from reactivation of abandoned wells. Additionally, it is known that the life span of a recommissioned well is short.

The highly praised "new discoveries" are actually formations that were thoroughly explored before 1944. Great emphasis is laid, for example, on the Moldavian region—particularly on the Bacau developments. The latter have been developed since the 17th century, and during the last war were re-explored by private companies.

The Gorj-Valcea region was drilled in 1905. Only the Pitesti region—where presently the Costesti, Valea Caselor and Branet fields are being developed—had been explored to a lesser degree prior to 1944. Earlier interest in this area was discouraged by Mrazec's theory that there were no commercial deposits between the Dambovita and Olt rivers.

The pre-war international price level rendered unprofitable the development of these alleged "new discoveries." To cover expenses alone, a well had to yield a minimal cumulative production of 350,000 barrels. The Buzau formations promised an average output of only 250,000 barrels per well; those drilled at Bacau, Targoviste and Gorj, even less. Development of these regions incur such high expenses that a private company would be ruined unless it could balance them with proceeds returned by richer operations elsewhere.

These are the unadorned facts about the "new discoveries" and "additional sources" currently claimed by the present political regime in Roumania. There is, however, an additional fact which will throw more light on the actual nature of the Roumanian oil "planning." Serious and objective studies based upon the known realities at the beginning of 1948 showed that no more than 260 wells could be drilled in the known deposits that were promising a profitable operation. Drilling beyond this number was considered too risky.

About the Author

G. G. ROSU is a former assistant professor of the Institute of Economics of the University of Berlin, a former economic counsellor of the Roumanian Ministry for Foreign Affairs, and he has written previously for WORLD OIL. He holds doctorate degrees in economics and law for which he studied at the Universities of Bucharest, Berlin and Paris. As Roumanian ministry counsellor, Rosu was in charge of the legal and political postwar problems of the Roumanian oil industry.

Rich Strikes Out. Since unexpected rich strikes must be counted out for the remaining short life span of the Roumanian oil industry, an estimate of the current output must be based only upon known field potentialities and long-range trends. Roumania's possible oilbearing area may be as wide as 4 million acres, but the probable reserves do not exceed 50,000 acres.

From the outset, two factors are important:

- Gas pressure is very low. Average yield per well per year, as well as per foot drilled, is steadily declining.

Wells drilled during the past 15 years in the country's richest fields (Prahova, Dambovita and Targoviste districts) show a declining rate of at least 7 percent annually. More recent reports printed in the Roumanian press admit that, from 1949 onward, this rate increased alarmingly.

- The same declining results also characterize deepening operations in search for new horizons in the known or marginal formations.

The situation may be illustrated by comparison: in 1935-1936, initial flow of a new well was between 400 and 1800 barrels a day. In 1947-1948, the expected maximum flow was not higher than 400 barrels per day. Prior to 1938, a well yielded a cumulative production of between 450,000 and 3 million barrels, while in 1947-1948, the expectancy diminished to between 275,000 and 800,000 barrels.

In the meantime, these terms of comparison have undoubtedly become more unfavorable.

Consequently, to keep production at a constant level under these conditions, drilling activity had to be expanded from year to year. In other words, rapid aging of active wells had to be compensated for through a higher footage drilled.

This explains the tremendous drilling efforts made after 1948. And it explains why output creeps up at an extremely low percentage despite increases in footage drilled as compared to pre-war levels.

Obviously, Soviet planners who conceived the Five-Year Oil Plan discarded these observations as too pessimistic. Yet, actual results have gone far astray from their over-optimistic targets.

Table 1 is computation of present production capacity of the Roumanian oil fields. Table 2 is a computation of the actual 1953 crude output of Roumania.

The difference between this realistic estimate and the official figures issued last August (69.7 million barrels) is 15.9 million barrels. It is still a moot question whether, last August, the Roumanian officials were counting their chickens before they were hatched, or whether they exaggerated the output figure for some specific purpose.

TABLE 1

A Computation of the Present Production Capacity of Roumanian Oil Fields[1]

Total drilling between 1947 and 1953	12,489,000 feet
Minus 10 percent for deepening and reparations	1,249,000 feet
	11,240,000 feet
Drilled effectively for new wells of which—according to official indications—for exploration purposes	4,490,000 feet
Balance drilled for development	6,750,000 feet
The average footage drilled for an exploratory well is 6000 feet. Thus, the total number of exploratory wells drilled is	750
The average footage drilled for a producing well is approximately 4200	

Continued on Page 232

So successful have been our Pelton Long Stroke Hydraulic Pumping Jacks that we now apply basically the same hydraulic principle to the short stroke. And here for the first time you see a thoroughly field tested beam pumping jack actuated by smooth uniform hydraulic forces.

Inherent design of the unit with its adjustable up and down stroke speed control affords maximum bottom hole pumping efficiency along with an extremely low overall operating cost. No gears, equalizing arms, wrist pins, etc., to maintain. A small hydraulic pump does the big job easily and surely.

Cost of the Pelton B-4C Unit is most favorable—approximately 65% that of a conventional pumping jack of the same size. Check the many other features listed below. Send for complete catalog and prices. You'll want to put these low-cost Pelton units to work on your wells immediately.

Pelton

announces a *new*

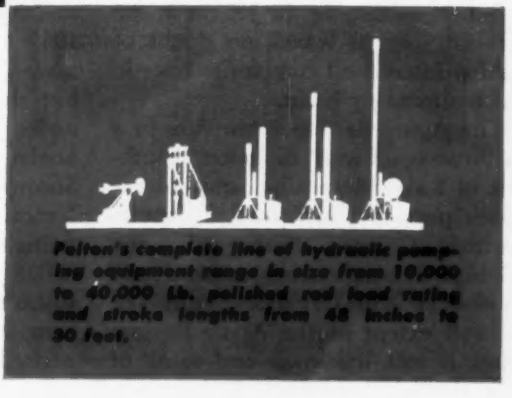
HYDRAULIC PUMPING JACK

for stripper and low production wells

1. MAX. POLISHED ROD LOAD, 12,000 POUNDS.

   Stroke lengths up to 48 inches.
   6 or 8 maximum SPM.
   Adjustable to less than 1 SPM.
2. LOW INITIAL COST.
3. LOW MAINTENANCE COST.
4. ADJUSTABLE UP AND DOWN STROKE SPEEDS give maximum bottom hole pumping efficiency.
5. AUTOMATIC LUBRICATION OF ALL BEARINGS.
6. PARTIALLY WEIGHT COUNTER-BALANCED.
7. IDEAL FOR HEAVY CRUDE PUMPING.
8. COMPLETELY FIELD TESTED.
9. UNIT FURNISHED COMPLETE with sheaves, belts, belt guards, engine mount, wire rope sling and rod hanger.
10. 12 MONTHS GUARANTEE.

Model B-4C Pelton Hydraulic Beam Pumping Jack.



Pelton's complete line of hydraulic pumping equipment range in size from 10,000 to 40,000 lb. polished rod load rating and stroke lengths from 48 inches to 30 feet.

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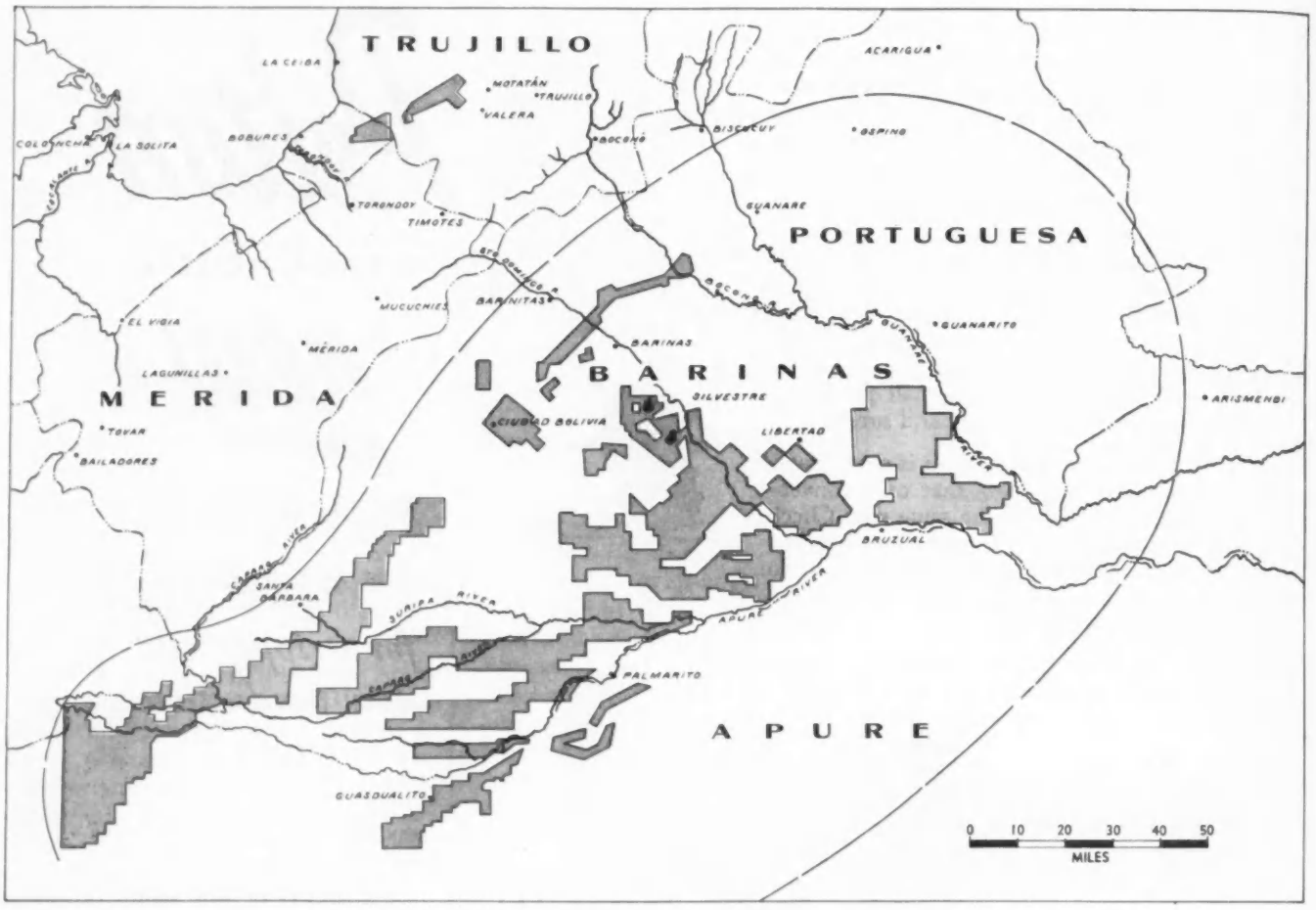


THE APURE-BARINAS BASIN, enclosed by broken line, contains two oilfields (shown in black) concessions as shown in red.

Apure-Barinas Concessions Ban May End

Eighteen months of surface exploration in sedimentary basin area points to top interest held by oil companies.

By ROBERT E. SPANN, WORLD OIL Staff

WESTERN VENEZUELA'S Apure-Barinas Basin will be the spotlight of activity when the Venezuelan government decides to end its nine-year ban on granting additional concession acreage to oil producers. Just when such action may be taken is pure conjecture, but the extent of surface exploration activity in the region in the past 18 months leaves no doubt of the top interest oil companies have in this sedimentary basin.

The Apure-Barinas Basin runs in a northeast-southwest direction, southeast of Lake Maracaibo, and encompasses parts of the states of Apure, Barinas, Cojedes, Portuguesa, and Táchira. It also extends southwest of Venezuela into Colombia. Although the full extent of the Apure-Barinas Basin is still unknown and some of the prospective area that can be considered as part of it has been eliminated from interest by the drilling of dry holes, the region represents one of the few promising basins in Venezuela in which open acreage is available.

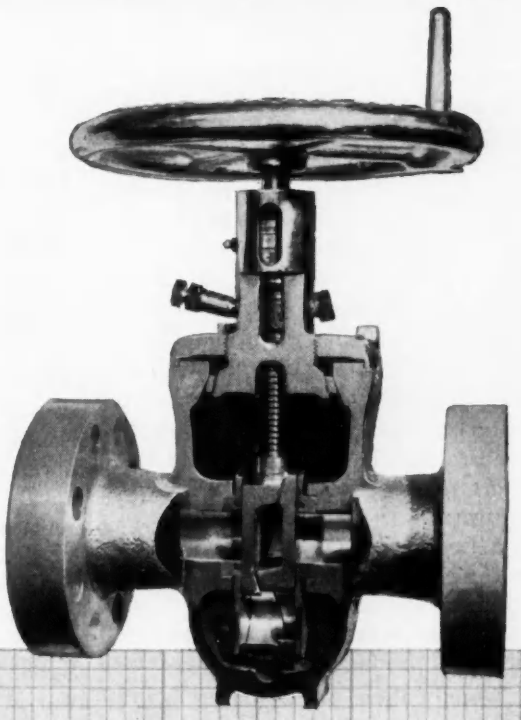
This basin is not "new" to Venezuelan oil interests since up until 1947 at least five companies held acreage under concession in the area, but through normal relinquishments under Venezuelan law, concession holders have dwindled to two—Socony-Vacuum Oil Company of Venezuela and Sinclair Oil and Refining Company. The latter has about 600,000 acres, and Socony has considerable more. The interest of other companies in the area can be appraised, however, when it is realized that one third of all the party months spent in surface exploration in Western Venezuela in 1953 was in the Barinas area.

Socony-Vacuum confirmed the presence of oil in Barinas State in 1947 with the discovery of its Sylvestre field and since that time has completed five shut-in producers in the Sylvestre and the nearby Silvan fields. The company also drilled seven dry holes in the area, and the average depth of its wells is 10,000 feet. The producing wells, Sylvestre 2, 3, 5 and 6 and Silvan 1 encountered oil sands reportedly of Eocene age at a minimum depth of 8600 feet. Gravity of the oil is reportedly 27.

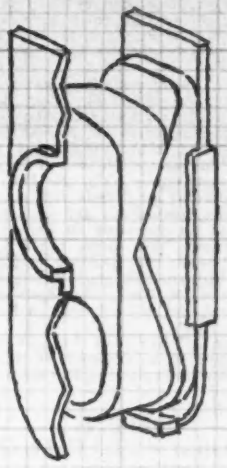
Additional and more recent interest in the region was stimulated by dis-

A SEAL ON BOTH SIDES

MEANS DOUBLE PROTECTION



Two-piece parallel expanding gate construction gives positive up-and-down-stream seal.

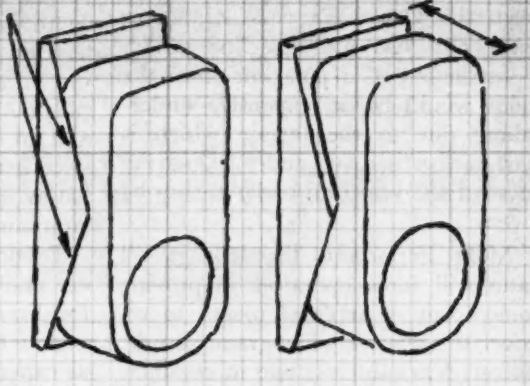


Gates in closed position with near skirt and seat cut back

The W-K-M design offers by far the most effective seal of any other design. In closed position, the split gate with its parallel faces, seats so tightly against both upstream and downstream seats that it is as positive a seal as a steel plate welded across the conduit. Yet, the gates move freely under all conditions when opening and closing the valve. The sketches at right illustrate the general construction of the gates.

All four planes in intimate contact

Now width of gates is greater

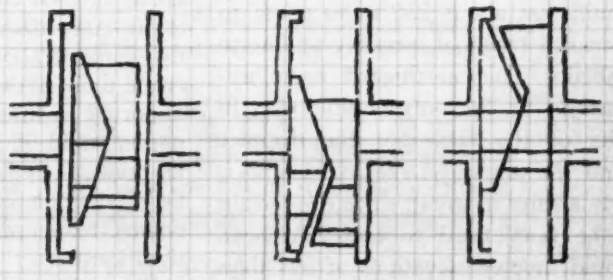


This sketch shows the general construction of the gates. The left pair is in the operating position. Both inclined planes are in intimate contact and the distance from face to face we'll call X. The right sketch shows how the gates appear in expanded position. One gate has been moved up which increases the overall width to X + △X, a width just great enough to provide the desired seating pressure.

The first cross-section sketch, right, illustrates how the gates move within the valve in operating position. The distance from gate face to gate face (X) is a few thousandths smaller than the distance between the seats, thus providing for completely free running while the valve is being operated.

The second sketch shows the position of the gates when the valve is closed. Here the solid portions of the gates bear against the seats at a high pressure obtained by the stem screw and the inclined planes of the gates. It can readily be seen that there is a complete seal on both sides so that direction of flow or pressure have no effect whatever on the perfect seal of the valve.

The last sketch shows the valve in open position. The same seating pressure bears against both seats, but the gate conduits are lined up with the valve conduit providing a smooth, full bore passage for the line fluid. Seating tightly on both sides prevents pressure and foreign materials from entering the body.



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covery of oil by Sinclair, also in Barinas State, with its Sinco 1 in May, 1953. The discovery well was drilled to a total depth of 9471 feet and found three sands, reportedly topped at 8560, 8986 and 9140 feet. On short test, the well produced at a rate of 1300 barrels daily of 25-27 gravity oil. Sinco 2 was drilled to 9472 feet in 1953 and produced, on test, at a rate of 1600 barrels per day of 25-26 gravity oil.

Sinclair currently has two rigs in the area and its Sinco 3 well at last report had been drilled to 9700 feet but was fishing a stuck cementing tool at a depth of 8653 feet. The No. 4 well has been spudded in and the company currently is erecting tankage of 80,000 barrels capacity to permit a full production test of the wells.

None of these producible wells has been placed on commercial production and there appear to be two primary reasons that have held up full development after these discoveries were made. First, the area is 230 miles from the Caribbean coast of Venezuela and has no pipe line outlet. Construction of a pipe line from the fields would be an expensive undertaking due to the terrain which is part mountainous and part marshy most of the year and badly cut up by rivers.

More important, the low gas-oil ratio will force operators to provide some form of artificial means to recover the relatively low-gravity crude. Socony-Vacuum is active in conducting experiments both in its research laboratories and in the field to find a method to see if the field can be made to pay out.

A possible pipe line route from the area that has been surveyed would run about 230 miles north to a coastal terminal, possibly at Puerto Cabello. This northward route appears to be the only feasible one, in spite of the fact that the distance from the area to Lake Maracaibo is only a third as great, since the terrain to be traversed to the Caribbean would involve elevations of less than 2000 feet. The westward route to a terminal on the lake would have to cross the Venezuelan Andes in the states of Trujillo and Mérida which have a peak elevation of 16,500 feet and the lowest passes at elevations of around 10,000 feet.—**The End**

Private Enterprise

Continued from Page 219

cession held by Esso Standard was granted in 1952 for a five-year period. Esso Standard is owned 63.3 percent by Standard Oil Company (New Jersey), 18.3 percent by Gulf Oil Corporation, and the remainder by French private capital.

In recent years several American companies, including California Texas Oil Company and Conorada Petroleum Corporation, have applied for concessions, but failed to receive approval because of French requirements of national ownership.

Other than the Esso Standard discovery, oil exploration and development activities in France and most of the nation's colonies have been conducted by French capital companies. And in each of the latter organizations, the government's Bureau de Recherches des Petroles (BRP) holds a major interest. To date, the ten French companies with a ten-year program which will end in 1956 have a total planned capital expenditure of $460 million. While they have conducted an extensive exploratory campaign throughout metropolitan France and in several colonies, results have not been impressive, except for the major Lacq discovery in 1949 in the Aquitaine Basin.

Economically, the Parentis discovery undoubtedly will prove a windfall for France in foreign exchange savings if the field proves to be as good as expected. Lacq field, discovered by Societe Nationale des Petroles d'Aquitaine (SNAP), now produces about 6000 barrels a day. Total production in France and the French Union is only about 11,000 barrels daily.

France has a domestic demand of about 300,000 barrels daily and—due to its large domestic refining capacity—imports about 450,000 barrels of crude daily. Balance of the volume is imported as finished products. If the nation could fill a large percentage of its domestic requirements for domestic production, savings in sterling and dollars for crude imports would be significant.

Before Parentis 1 is placed on commercial production, a producing company has to be formed in which the French government will hold a ten percent interest. However, Esso Standard has moved a second rig into the area and has staked locations for two offsets.

Roumanian Oil

Continued from Page 228

feet.[2] Hence, the number of producing wells drilled in this interval is		**1,607**
Total wells drilled between 1947 and 1953		**2,357**
Plus wells in production on Jan. 1, 1947		**1,969**
Total		**4,326**
Minus 25 percent, representing accidents and dry holes, as well as the annual rate of exhausted wells		**1,082**
Balance		**3,244**
Total recommissioned old wells	**496**	
Failures as well as those exhausted in the meantime	**165**	
The producing share of reactivated wells		**331**
Total producing wells on Dec. 31, 1953		**3,575**
Of which: Old wells	**3,127**	
New wells	**448**	

[1] With the exception of the 1953 figure—which was estimated—footage drilled is that announced officially. The percentage deducted for reparations and deepenings may be slightly optimistic. In view of the frequently published complaints about failures and accidents, it is possible also that the percentage deducted for this entry may be slightly optimistic. In these cases, final results would be to the advantage of the official claims for production levels.

The number of active wells in January, 1947, has been taken from the official statistics published in *Le Moniteur du Petrole*, Bucharest. The same periodical has also been consulted for computing the declining rate of the output per well per year.

The number of reactivated wells has been computed from reports published in the 1947 and 1948 issues of *Le Moniteur du Petrole* and, subsequently, in the daily press, periodicals and broadcasts.

In addition to *Le Moniteur du Petrole*, the following publications have been checked, starting with the issues available since 1949 or 1950: *Scanteia, Munca, Universul, Scanteia Tineretului, Contimporanul, Petrol si Gaze*, and *Analele Sovieto-Romane*, all published in Bucharest, in Roumanian.

[2] This average is lower than the prewar and the pre-1944 averages, as a consequence of increased drilling in shallower formations, like those of Bacau, Gorj and Pitesti.

TABLE 2
A Computation of 1953 Crude Output in Roumania

According to trends observed during the last 15 years, the declining rate of the fields averages 7 percent annually. Consequently, the output of an old well—computed by extrapolation—was, in 1953, 30.45 barrels per day.

The output of all 3127 old wells may have thus reached, barrels per day	**95,217**	
and, for the whole year a total of		**34,754,260 barrels**
The output of a new well in 1953—computed as above—averaged 55.50 barrels per day		
All the new wells produced per day	**24,864 barrels**	
and, during the whole of 1953, a total of		**9,075,360 barrels**
The output in 1953: barrels per day	**120,081**	**43,829,620 barrels**

End Part 1

PIPE LINE PROGRESS

Dope gang preparing a string of A. O. Smith 26-inch welded steel line pipe for lowering in on the West Texas Gulf Pipe Line.

Biggest Inch to carry 381,000 bbl. per day from Permian Basin area

The West Texas Gulf Pipe Line, completed last February, is the largest single carrier of crude oil in this country. It has 465 miles of 26-inch pipe which extends from Colorado City in west Texas to Lucas, just outside Beaumont.

Present capacity of 301,000 barrels per day is being increased to 381,000 by the addition of intermediate pumping stations. Ultimately, capacity can be increased further to an estimated 440,000 barrels per day.

Crude oil from the Permian Basin area, containing more than 20% of the nation's oil reserves, is delivered to the Beaumont area and, through a 20-inch branch of 112 miles, to Longview, Texas, where it connects with other pipe lines serving Great Lakes and Ohio River valley refineries.

A considerable mileage of the 26-inch line is of A. O. Smith welded steel line pipe produced in Milwaukee and Houston. We are proud to have contributed to the construction of this, the Biggest Inch, as we have also to virtually every important petroleum products pipe line in the world.

A. O. Smith Line Pipe is available in a complete range of sizes and wall thicknesses, from 8⅝-in. to 36-in. diameters.

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DEPENDABILITY THROUGH RESEARCH AND ENGINEERING

What's Happening

AMONG WORLD OIL MEN

LEO W. STACH of Tokyo, Japan, technical consultant for development of oil and natural gas resources in the Far East, has accepted an assignment for one year as petroleum geologist with the United Nations Technical Assistance Mission to Taiwan (Formosa). He will advise and assist the Chinese Government in exploration and development of petroleum resources.

Stach was previously in Taiwan in 1952 at which time he recommended an exploration program to the Chinese Petroleum Corporation which resulted in discovery of commercial production of light crude at Chutauchi field in January, 1954.

His headquarters in Taiwan are at 71 Goan Chyan Road, Taipei, Taiwan.

•

J. A. WARKE has been appointed district superintendent for the Central Alberta District of Socony-Vacuum Exploration Company. A member of the Engineering Institute of Canada and the Association of Professional Engineers of Alberta, Warke was born and educated in Alberta.

J. A. Warke

From 1929 to 1946, he worked in Turner Valley, the last 9½ years for Brown, Moyer and Brown Ltd. as field foreman and field superintendent.

In 1947 he went to the Middle East as production foreman in charge of the production division of Bahrain Petroleum Company. Warke returned to Alberta at the end of 1952 and joined Socony-Vacuum Exploration in January, 1953.

•

MILLER W. QUARLES, JR., chief geophysicist for Precision Exploration Company, is in Israel as a seismic survey expert for the United Nations Technical Assistance Administration, where he will remain until August. Quarles, who makes his headquarters in Houston, Texas, in charge of the Gulf Coast division, is a graduate of California Institute of Technology and is the author of several technical papers on geology and geophysics.

M. W. Quarles, Jr.

•

E. E. BARBERII, National University of Zulia, Maracaibo, Venezuela, arrived in the U. S. March 17 to visit schools specializing in petroleum engineering and oil field service companies in behalf of the University's

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3. The BLADE SECTIONS of SPANG BITS, designed for maximum penetration in hard formations, have ample water course to provide more room for cuttings and faster drilling action in sticky formations.
4. SPANG BITS are furnished with *semi-dressed drilling ends* which permits a bit to be dressed out to gage in less time and with fewer heatings.
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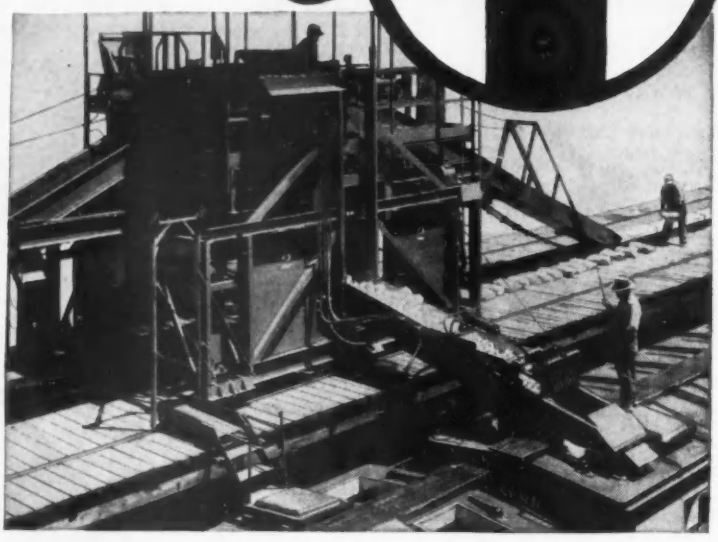

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General Freight Traffic Manager, Santa Fe Lines
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planned Petroleum Engineering School, of which he is director.

Formerly a member of the petroleum engineering faculty at the University of Tulsa, Barberii went to Mexico in 1952 as chief petroleum engineer for Mexican American Independent Oil Company. At the close of 1953, he accepted an offer from the University at Zulia to head its proposed engineering school.

•

M. L. Haider

L. P. Maier

MICHAEL L. HAIDER has been elected president of International Petroleum Company, Ltd., an affiliate of Standard Oil Company (N. J.). He succeeds L. P. MAIER, who became chairman of the board. Haider previously was deputy coordinator of Jersey Standard's world-wide producing activities. Maier had been president of International for nine years. The company, incorporated in Canada, has its principal activities in Colombia, Peru and Venezuela.

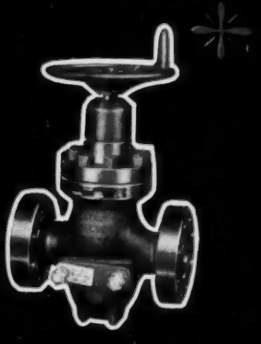
•

DOUGLAS ROBINSON, Q. C., has been appointed a vice president of Canadian Oil Companies, Ltd. Robinson originally set up the company's Legal department and has served as general counsel and secretary of the company in recent years. During World War II, he served as personal assistant to the oil controller for Canada.

•

W. A. M. GREEVEN has been elected a director of the Creole Petroleum Corporation, an affiliate of Standard Oil Company (N. J.), operating in Venezuela. Greeven joined Standard of New Jersey in 1925. He was shareholder's representative of the Jersey interests in North Africa, Spain and Portugal when he resigned in 1950 to join Creole at Caracas.

Creole also announced the appointment of B. M. OWEN as an assist-



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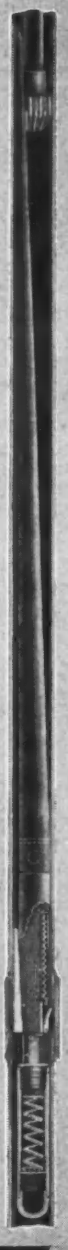

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ant treasurer. Owen joined Jersey Standard interests in 1937 when he became associated with the Colonial Beacon Oil Company. At the time of his new appointment, he was division head in the financial section of the Accounting department in the New York office.

At the same time, Creole announced the resignation of Dr. Cecil L. Burrill, director and vice president, who has returned to Standard of New Jersey as manager of the General Economics department.

•

E. D. LOUGHNEY has been elected a vice president of the Canadian Gulf Oil Company, a subsidiary of the Gulf Oil Corporation. Loughney, a veteran of 26 years with Gulf companies, has been general manager of Canadian Gulf Oil Company. He will continue to be responsible for the company's expanding oil exploration and production operations in Canada.

E. D. Loughney

•

W. W. GRANT has been named assistant to the manager of the Texas Petroleum Company's Caracas office. Previously, he has been chief accountant for the firm at Bogota.

Other promotions announced by the company include J. O. Canfield, geophysicist in the Venezuelan Division, named geophysical supervisor in the Colombian Division; and E. G. Dobson, formerly chief petroleum engineer in the Venezuelan Division, named chief engineer in the Foreign Producing department of the Texas Company, New York.

•

The following personnel changes were made recently by Creole Petroleum Corporation in Venezuela: EZRA W. DRAKE—senior drilling administrator, Tia Juana; formerly supervisory petroleum engineer, Maracaibo. SAMUEL J. MATHIS—assistant district superintendent, La Salina; formerly supervisory engineer, La Salina.

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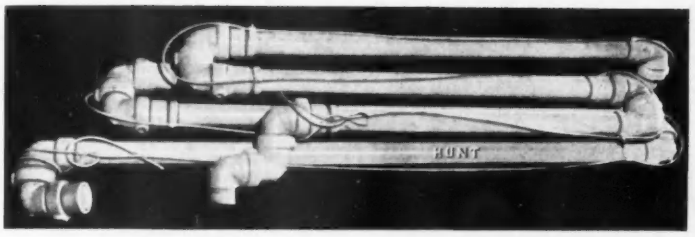
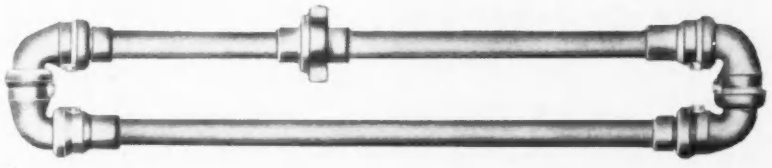
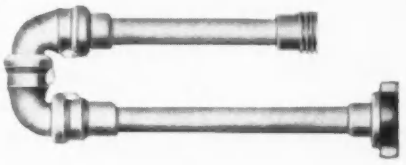


Hunt All-Steel Drilling Hose uses the new forged steel double ball swivel joints which give extreme flexibility and strength. Available for conventional and jackknife derricks. 3" and 4" sizes 5,000 psi working pressure at 225° F.



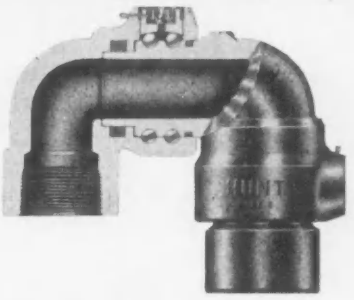


Hunt All-Steel Circulating and Cementing Hose — 2", 10,000 psi working pressure at 225°F. — is made up in standard and half sections utilizing Hunt Swivel Joints and standard hammer unions.

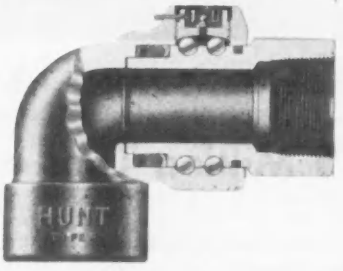
*Write for catalog; shown on page 2315 of Composite Catalog.

Order From Your Supply Store

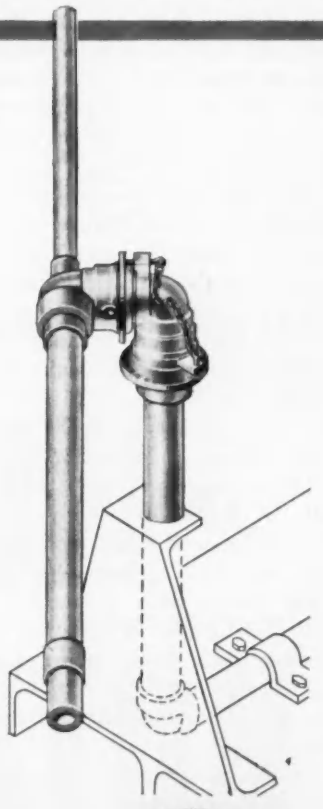
The Hunt Mud Gun — 2", 5,000 psi at 225°F. — swivels in all directions at two swivel points and is equipped with locking rings. Heat treated replaceable nozzles in ½", ⅝" and ¾" diameters available.



Recommended for cementing service, the Type E forged steel swivel is available in 2" size for 10,000 and 15,000 psi working pressure at 225°F.



For OWG only, use Type D, forged steel swivel joint, 5,000 psi working pressure at 225° F and for high temperature service use Type D forged steel swivel joint, 500 psi working pressure at 600° F. Available ¾" to 4" inclusive.



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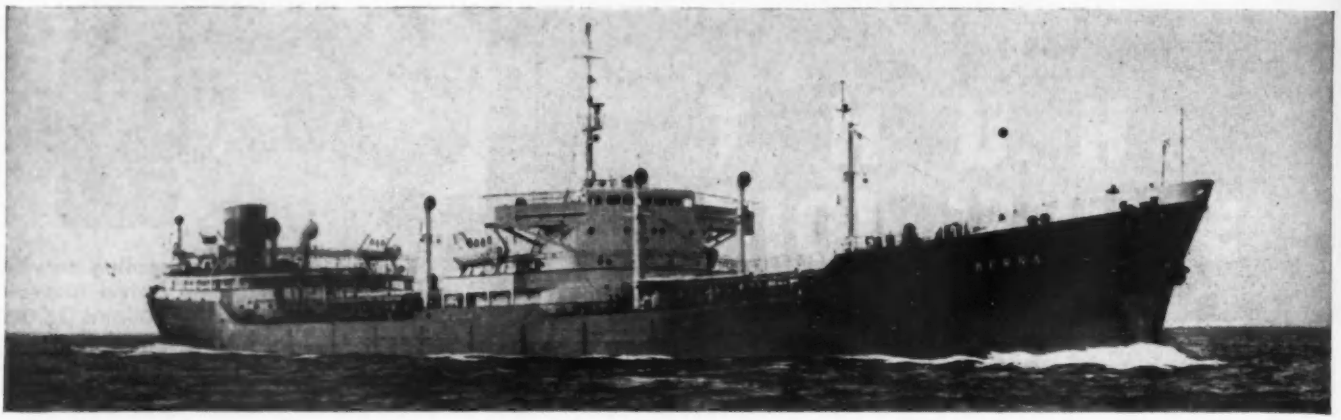

MOTOR TANKER BERNA, 18,800 tons deadweight, was built at Monfalcone, Italy, for Swiss shipowners.

1.5 Million Tons of Italian Shipping Predicted by End of Year

At year's end Italian tanker tonnage should reach about 1,500,000 tons d.w., according to Italian shipping circles as activity of Italian shipowners increases. Only Cantieri Navali Riuniti-Cantieri del Tirreno of Genoa have been busy on construction of three turbotankers of 19,000 tons deadweight of which two were ordered from their Ancona shipbuilding yard by Compagnia Internazionale di Navigazione of Genoa and from their Palermo shipbuilding yard by the Sicilia Societa per Azioni di Navigazione.

The first two have been named Giorgio Fassio and Ernesto Fassio, Jr.; the third Conca d'Oro. These vessels have the following dimensions: length between the perpendiculars, 527 feet; maximum breadth, 73 feet; height to the main deck, 40 feet; draught at full load, 31 feet; gross carrying capacity, 19,000 tons dw; trial speed at full load 16.842 knots.

The turbine propelling machinery, built by Stabilimento Meccanico of Riva Trigoso (Genoa), consists of a high and low pressure turbine designed to develop a normal power of 10,000 brake horsepower at the speed of 115 revolutions per minute and a maximum power of 11,000 bhp at a correspondent number of rpm.

At Ancona yard of the Cantieri Navali Riuniti, keel of a tanker ordered by the Columbia Societa Marittima per Azioni has been laid with the following dimensions: length, 589 feet; height of construction, 41 feet; breadth, 77 feet; gross tonnage, 21,500; gross carrying capacity, 33,000 tons dw., power of propelling machinery, 12,500 bhp. This is the first tanker ordered in the postwar period by American oil companies from Italian yards.

MOTOR TANKER FI'AMMA, also 18,800 deadweight, built at the Monfalcone yards for Italian shipowners.

Adriatic shipowners recently have placed into operation the motor tanker Dogaressa built by the Cantieri Riuniti dell'Adriatico at Trieste on order of the Societa Italiana di Armamento Marittimo Sidarma of Venice with the following dimensions: gross tonnage, 13,700; gross carrying capacity, 18,000 tons dw; power of diesel machinery on sea trials, 14,000 bhp. with an average speed of 16.57 knots and a maximum speed of 18 knots.

As a whole there has been a standardization tendency in the Italian tanker construction during 1953-1954. The ships built in Italy may be grouped in three classes:

- Supertankers of 32,000 tons dw with turbine gearing and four cargo pumps of 7700 barrels an hour each, allowing the unloading of the whole cargo in about 8 to 10 hours.
- Supertankers of 24,000-27,000 tons dw some with turbine propelling machinery and a speed in service of between 14 and 17 knots, and some with diesel machinery and a speed in service between 16 and 18 knots.
- Tankers of 18,000-19,000 tons dw in greatest part with turbine machinery with very different ranges of speed in service varying from 14 to 17 knots.

To help construction of such tonnage, the Italian Government has granted to Italian shipbuilders a premium per gross ton which covered about two-thirds of the difference between the Italian and the British cost of construction.

Italian tanker shipowners favor reestablishment of the International Tanker Tonnage Pool, and are negotiating on a pooling agreement between the Italian coasting tankers to prevent unhealthy competition in the Mediterranean Sea.

Though no official statement has been issued in connection with the Italian attitude before the Saudi Arabian-Onassis agreement it is understood that the Italian shipowners are to support the action of the International Chamber of Shipping.

Why this special oil field jack will give longer trouble-free service

the Roustabout "1523"

When Duff-Norton engineers set out to design safer, longer-lasting jacks for men who work in the oil fields, they discovered one startling fact—about 90% of jack maintenance was in replacing worn springs in the mechanism that controls the jack's raising or lowering action. Result? The Duff-Norton Roustabout "1523" oil field jack is equipped with a patented*, adjustable spring mechanism which assures positive engagement of rack teeth. The spring's tension can be easily adjusted with a screw driver without removing any part of the jack. Should the spring eventually lose its resiliency, there's no need to send the jack to a repair shop. A new, complete spring mechanism assembly can be quickly installed by anyone in a matter of minutes right in the field, making the jack as good as new!

Complete with detachable steel chain, this versatile jack can be operated at any angle at its full 15-ton capacity. Ask your supply store salesman for the Duff-Norton Roustabout "1523." He has it in stock or can get it for you quickly. For complete specifications on this and other dependable Duff-Norton jacks, write the world's oldest and largest manufacturers of lifting jacks for special Oil Field Jack Bulletin AD19C, The Duff-Norton Manufacturing Co., P. O. Box 1889, Pittsburgh 30, Pa. Canadian Plant—Toronto 6, Ontario.

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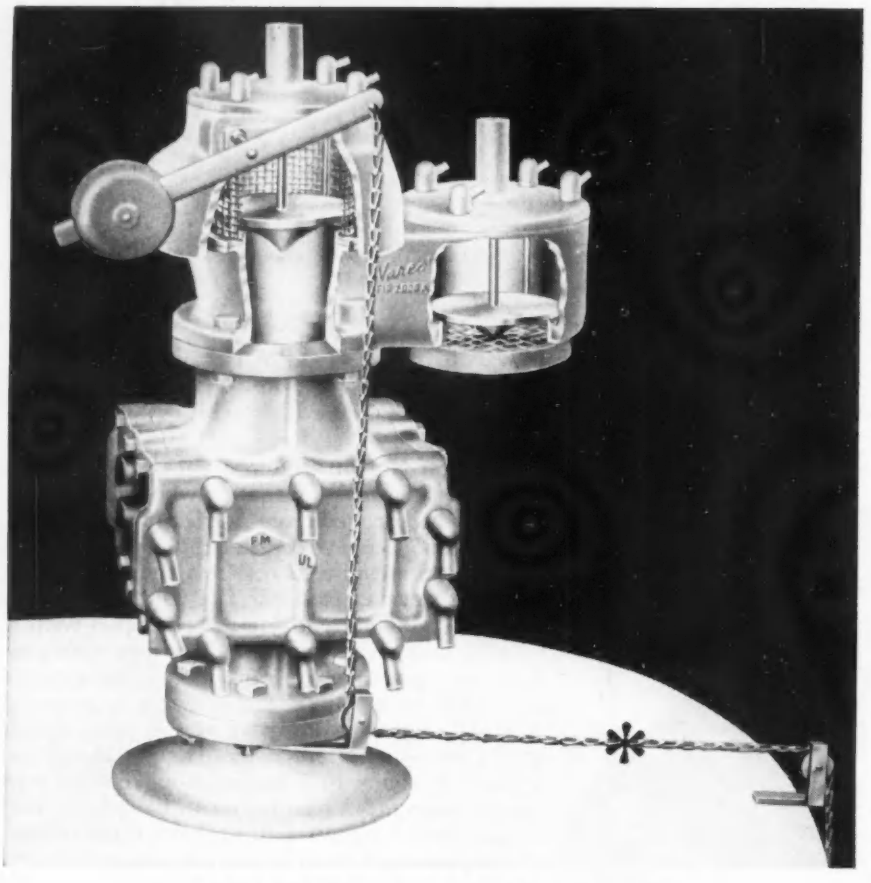

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* *Remote Control Flame Snuffer Sheave Brackets, Fig. 130 are optional at extra cost. This assembly is preferable where vent unit is set back from edge of tank.*

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58-1

Ragusa Says Structure Extends Beneath Town

Ragusa, Sicily, reports indicate that American International Fuel and Petroleum Company (Gulf Oil Corporation) has discovered an oil structure extending beneath the entire surface of Ragusa.

In July, when production reportedly will begin on the first and second wells drilled, each well is expected to yield between 500-1000 barrels of crude daily. In addition, a third well is reportedly planned in the central area of Ragusa.

It is estimated that in 1955 about six wells will be in operation in the Ragusa region, with annual production of more than a million barrels.

Following the discovery of oil in Sicily, an increase in the annual capacity of the RASIOM Augusta refinery is projected. In addition, a pipe line from Ragusa to Augusta is under study.

Permit for New Canada Pipe Line Will Be Sought

Application for permission to construct a 155-mile, 16-inch crude oil pipe line from the Fosterton-Cantuar and Success fields of southwestern Saskatchewan to Regina, Saskatchewan, will be made by Socony-Vacuum Exploration Company in association with Woodley-Canadian Oil Company and Southern Production Company. At Regina, the crude will enter the system of Interprovincial Pipe Line Company. Initial capacity of the new line will be approximately 20,000 barrels per day. The group hoped to start construction about July 1, with completion of the line scheduled for about June 1, 1955.

The crude, ranging between 21 and 24 gravity, is obtained from more than 100 wells in the three partially-developed fields. Lack of a pipe line outlet in the area until now has been a retarding factor in the development of the fields. The Fosterton field was discovered in 1952.

Socony, Woodley and Southern Production have contracted to supply this type of crude to a refinery now being constructed by Great Northern Oil Company in the St. Paul, Minn., area.

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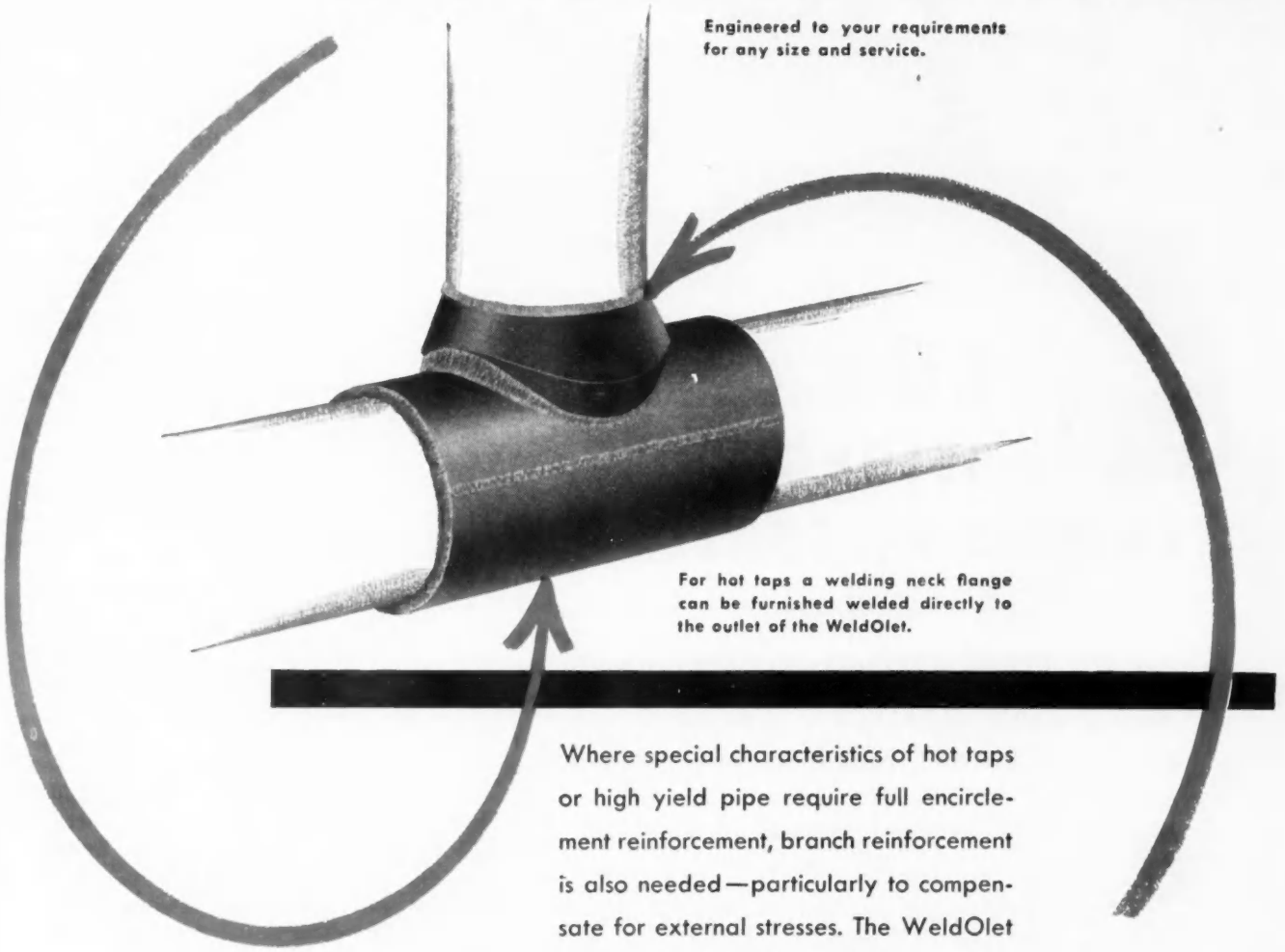
New WeldOlet Split Tee for hot taps and new construction

Assembled and Ready for Field Installation, the WeldOlet Split Tee "Nails Down The Lid" where Full Encirclement Reinforcing is Needed.



Engineered to your requirements for any size and service.

For hot taps a welding neck flange can be furnished welded directly to the outlet of the WeldOlet.

Where special characteristics of hot taps or high yield pipe require full encirclement reinforcement, branch reinforcement is also needed—particularly to compensate for external stresses. The WeldOlet Split Tee satisfies this combined requirement in the most economical manner.

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Tests show that daily use of COREXIT — the corrosion inhibitor for sour crude, gas condensate and other oil wells — can save you up to $800.00 per well per year. COREXIT'S patented compound protects against the severe corrosive conditions in wells by building up a protective coating on tubing and sucker rods.

Protect your sucker rods and tubing from corrosion and hydrogen embrittlement. Call the nearest Humble Wholesale Agent (in Texas) for on-the-lease delivery of COREXIT, or write:

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Jersey Standard Affiliate Gets Turkey Oil Permit

The government of Turkey has granted a non-exclusive exploration permit to a new Standard Oil Company (New Jersey) affiliate, Esso Standard (Turkey) Inc., enabling exploration activities throughout Turkey to be commenced immediately.

The permit, delivered to officials of Esso Standard (Turkey) at ceremonies in Ankara, was issued under the recent Turkish Petroleum Law. This law is among the most advanced petroleum legislation encouraging participation of foreign private enterprise in the development of the country's natural resources.

Late in 1952, Turkey announced its decision to reverse its policy of government-controlled economy. So it denationalized the petroleum industry and invited foreign oil companies to take part in the search for oil.

The granting of the exploration permit to Esso Turkey followed a preliminary survey of the prospective areas of Turkey by a Jersey Standard geological reconnaissance party.

Saskatchewan Government Claims Share in Oil

The Saskatchewan government in an unprecedented move has claimed a share in profits from the province's spectacular Smiley light-oil field—by far the biggest light-oil strike in Saskatchewan to date.

Resources Minister J. H. Brockelbank announced in the legislature completion of an agreement with a cooperative which grants development rights to valuable Crown oil reserves in the Smiley district, 125 miles southwest of Saskatoon.

The agreement granted rights to two sections of proven reserves adjacent to the Smiley field, which now covers 11 sections. It provides full development rights to Consumers Cooperative Refineries Ltd., with profits to be shared after initial capital investment is returned from oil production.

The province's share is 15 percent until the Cooperative regains its investment, rising to 60 percent with 40 percent to the Cooperative.

What's Happening

AMONG MEN IN THE INDUSTRY

Albert B. Stevens, head of the Department of Petroleum Engineering at A & M College of Texas, has resigned effective July 1 to become general manager of Farnsworth and Chambers Oil Company in Houston. Stevens has been at A & M since 1934.

A. B. Stevens

•

J. C. Connor has been appointed division gas superintendent for the Texas-New Mexico division of **Stanolind Oil and Gas Company.** He succeeds **D. W. Farnham** who was transferred to Brownsville, Texas, as synthesis plant superintendent in Stanolind's chemical plant.

•

M. S. Kendrick, Houston, has been appointed to the newly-created position of coordinator of offshore operations for **Continental Oil Company's** southern region. He will make his headquarters at Houston and will report to **O. L. Fisher,** general manager of Conoco's southern region. Kendrick joined Creole Petroleum Company in Venezuela in 1926 and has been associated with the firm in South America until recently. He was a member of Creole's management committee. A native of Dalhart, Texas, Kendrick attended the U. S. Naval Academy and took the advanced management course at Harvard University.

M. S. Kendrick

•

H. H. Bybee, Wichita Falls, Texas, has been appointed division geologist for **Continental Oil Company** with headquarters at Midland, Texas. Formerly division geologist at Wichita Falls, Bybee succeeds **C. D. Vertrees,** Midland, who was recently promoted to regional research geologist. **Max Levin,** Midland, geologist, has been promoted to district geologist. He will continue to make his headquarters at Midland. Bybee joined Conoco at Fort Worth in 1948 and was promoted to division geologist at Abilene, Texas, two years later. He was named division geologist at Wichita Falls in 1951. Before joining Conoco, Bybee was a geologist for seven years with The Carter Oil Company. Levin joined Conoco as a geologist at Fort Worth after his graduation from the University of Texas in 1951 and transferred to Midland the same year.

•

Stanwood I. Williams, formerly executive vice president of **Thomas P. Pike Drilling Company** of Los Angeles, has been elected president of the company. The election fills the vacancy created by the resignation of **Thomas P. Pike,** recently named assistant secretary of Defense by President Eisenhower. **Howell G. Haney,** vice president—operations, was named to a newly-created post, chairman of the executive committee of the board of directors. **Gene Graham,** vice president, was elected executive vice president. Graham also was named to the board of directors and will serve on the executive committee along with Williams and Haney. A graduate of Stanford University, Williams is well known in the contract drilling industry of California, having been an officer of Thomas P. Pike Drilling Company since 1944.

•

Humble Oil & Refining Company has announced the following changes in the Production department supervisory personnel: **C. A. Watson, Jr.,** advanced from farm boss to assistant district superintendent at the Athens district, East Texas division; **George E. Dick,** Pampa district, North Texas division, from roustabout derrickman to roustabout gangpusher; **J. T. Murff,** civil engineer, East Texas division,

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Tyler office, was made district civil engineer of the Sugar Valley district, Gulf Coast division; and **K. B. Purcell**, rotary driller, Avery Island district, Louisiana division, promoted to toolpusher in Grand Isle district.

•

William M. Martin and **Harold Crisman** have been named vice presidents of **Russell Cobb, Jr.**, Tulsa oil producing firm. Martin will be in charge of land and Crisman in charge of production. Martin took his A.B. degree at the University of Oklahoma in 1942 and served with the U. S. Marine Corps during the war. Crisman received his petroleum engineering degree at the University of Oklahoma and has been with the firm for more than a year.

•

Frank M. Ritchie of Houma, La., has been elected by the board of directors of **The Louisiana Land and Exploration Company** to serve as a vice president of the corporation.

•

Republic Natural Gas Company has established a division exploratory office at Suite 909 Warrick Hotel, New Orleans. **Jack F. Harang** has joined Republic's exploratory staff as division manager of Land and Geological departments. Harang was formerly chief geologist and geophysicist for the estate of William Helis for six years. Prior to that Harang was professor of geology and geophysics at Tulane University and formerly was associated with the Gulf Oil Corporation. Harang was graduated from Louisiana State University in 1940 with a B.S. degree in geology.

Harold S. Skinner, Fort Worth, assistant general manager of **Continental Oil Company's** southwestern region, has been promoted to administrative assistant to the president with headquarters in Houston. In addition, **J. J. Dorgan, Jr.**, Houston, assistant to the president since 1952, will join Conoco's Rocky Mountain region Exploration department in Denver August 1. The changes follow the recent appointment of **John G. McLean** as assistant to the president of Continental. Skinner joined Conoco's Legal department at Ponca City, Okla., in 1948. He was promoted to general attorney for the company's central region at Oklahoma City in 1951 and the following year became assistant general manager of the central region. He was appointed assistant general manager of the southwestern region at Fort Worth in late 1952. Dorgan joined Conoco in 1948 at Ponca City and two years later transferred to the company's Coordinating and Planning department at Houston. He served a year in Washington, D. C., with the Petroleum Administration for Defense while on leave from Conoco and was named assistant to the president of Continental with headquarters in Houston in 1952.

Harold S. Skinner

•

R. D. McGranahan has been elected a vice president of **Gulf Oil Corporation** and **C. W. Hurley, Jr.** has been appointed director of coordination. McGranahan, who will be responsible for the direction and coordination of all forms of transportation, joined Gulf in 1948 as a member of the executive staff and has been concerned with the coordination of transportation and requirements and use of storage. Hurley will be a member of the executive staff and will be responsible for coordination of all departments involved in meeting domestic and foreign sales requirements with maximum economy. Hurley joined Gulf as assistant chemical engineer at the Port Arthur, Texas, refinery. He became chief chemist seven years later and continued in this position until his transfer to the Pittsburgh office in 1934 as assistant to the general manager—manufacturing. In 1939 he was transferred to the Executive department where he was concerned with crude oil supply and the manufacture and distribution of products.

•

Lyman C. Dennis, consulting petroleum geologist in Wichita Falls, Texas, has accepted a position as chief geologist with **Russell Maguire** in Wichita Falls. Dennis was a geologist with The Pure Oil Company for 14 years working in Illinois, Mississippi and Texas, the last six years as district geologist in Wichita Falls. Since then he has been a consulting geologist for 2½ years working in the North Texas district.

•

R. B. Smith, Midland, Texas, has been promoted to the newly-created position of assistant to the regional land superintendent of **Continental Oil Company's** southwestern region. Formerly a landman at Midland, he will have headquarters in

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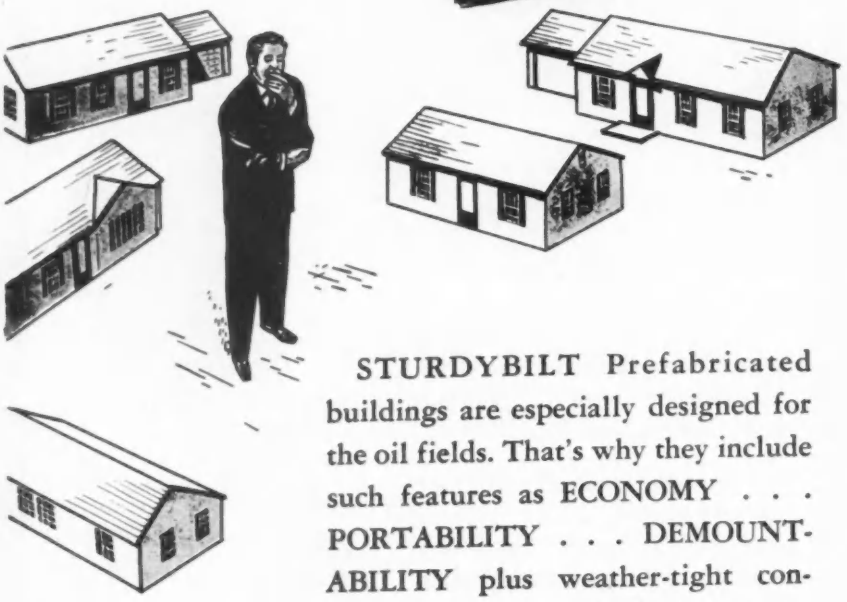

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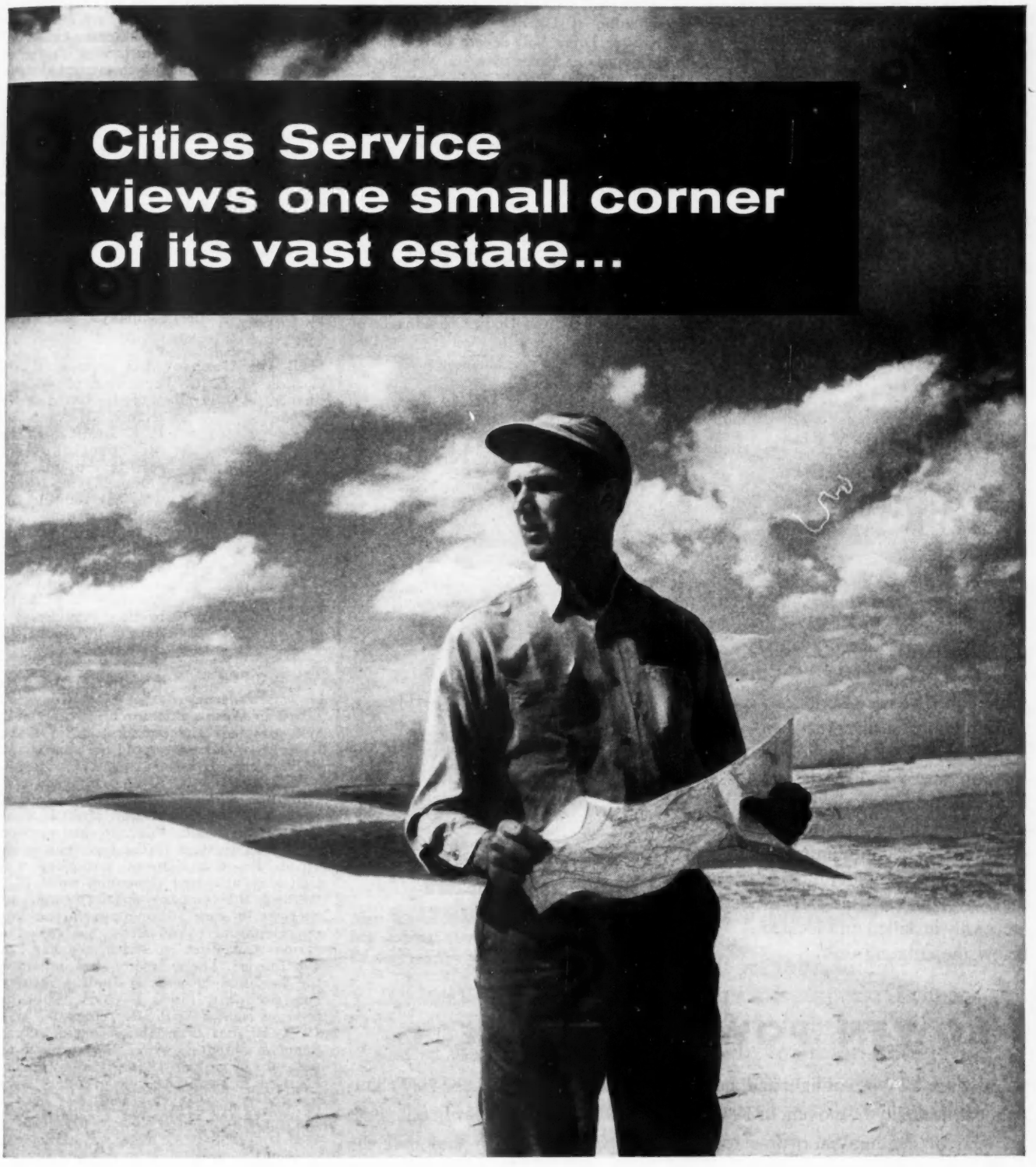

Eleven million acres of prospective oil and gas lands in the United States and Canada—in addition to holdings in South America, Egypt, and the Middle East—are under lease or owned outright by

CITIES SERVICE

A Growth Company

Fort Worth. **Norman Dingmore,** a member of Conoco's Marketing and Transportation department at Fort Worth since 1947, has been promoted to traffic representative at Albuquerque, N. M.

•

William M. Barret, Inc., consulting geophysicists, announces a change of address with occupation of its new offices, laboratories and shops at Linwood Avenue and Dalzell Street in Shreveport.

•

Raymond B. Kelly, Jr. has been named manager of the newly-created division office of **Calvert Drilling, Inc.** in Denver. Kelly joined the company in January. Formerly he was with Richardson and Bass and with Humble Oil & Refining Company.

Creslenn Oil Company has announced the resignation of **Charles E. Dimit** as vice president. Dimit will devote his efforts to developing oil production in the Rocky Mountain area with offices in Denver.

•

Charles E. Pittman, geologist, has resigned from **Champlin Refining Company,** Enid, to become chief geologist for Norbla Oil Company, Tulsa.

•

C. J. Kerwin and **John H. Douma** received increased responsibilities with a new alignment of **Sunray Oil Corporation** general office Production department personnel. Kerwin becomes superintendent of production for Sunray and Douma is manager of engineering for the Production department. Kerwin and Douma have shared responsibilities as superintendents of production for Sunray, Kerwin having charge of the West Texas and north central district operations and Douma the Arkansas, Louisiana and Gulf Coast district operations.

Kerwin will be production superintendent for the Mid-Continent division, and Douma will be manager of engineering phases of the company's production operations throughout the same area. In the new alignment within Sunray's engineering section of the Production department, **Dr. C. W. Ziemer** will be chief reservoir engineer; **M. S. Patton, Jr.,** has been named chief development engineer; **John D. Gassett** will continue in charge of the proration section and **Frank C. Folger, Jr.,** in charge of the company's unitization section.

•

Shell Oil Company has announced the election of **E. C. Peet,** vice president—finance, as a member of the board of directors. He replaces **P. E. Lakin,** formerly vice president and senior representative on the West Coast, who has retired after 39 years of service with the firm. Peet joined Shell in 1919 as a clerk. After serving as manager of the Auditing department in San Francisco, he moved to New York in 1940 as assistant secretary and assistant treasurer. During 1942 he was on loan to the War Production Board in Washington. Peet was appointed vice president and treasurer in 1944 and senior financial officer of the company in 1949.

E. C. Peet

•

California Texas Oil Company Limited has announced the election of **A. E. Ernst** as vice president. Prior to his election, Ernst was assistant to the chairman of the board. Ernst has been associated with Caltex or affiliated companies since 1936, the year the company was formed. Caltex operates in some 60 countries in the Eastern Hemisphere and Ernst has served in various capacities in Africa, the Far East and Europe. The company also announced the appointment of **R. E. Ludt** as assistant vice president, Fiscal Division. Ludt has been associated with the company since 1933. He has been almost exclusively in financial activities where he has held the positions of cashier, assistant treasurer and assistant to the fiscal vice president. During the past five years Ludt has been in charge of the company's Financial Planning department.

•

Lawrence J. Vittrup, geologist with **The Texas Company** for the past 21 years, has resigned to become vice president—geology with **Kilroy Company of Texas, Inc.** Started two years ago, the company has production and development work in West Texas, the Gulf Coast and southern Louisiana.

•

C. L. Dretzke has been appointed personnel assistant of the **Great Northern Oil Company.** Dretzke will supervise the selection and training of office and plant personnel which will approximate 200 persons by the time the plant is in operation late in 1955. The new plant will be located at Pine Bend on the Mississippi, 14 miles south of Saint Paul.

The Easiest and Quickest Powered Swivel to Use

THE BOWEN POWERED SWIVEL

Complete trailer mounting provides ease of getting the Swivel to the job. The use of self-sealing couplings insures ease of setting up Swivel. Direction of rotation, speed and torque are easily controlled by the operator from the control box. Swiveling hose connection eliminates any possibility of contaminating the Swivel because it is a separate, easily installed unit located below the rotating unit.

Eliminates Fire Hazard

Locating the trailer-mounted prime mover unit, which is equipped with spark-proof ignition and exhaust, at a safe distance from the well prevents all danger of fire hazard.

BOWEN POWERED SWIVELS

are used for all types of light and medium rotary operations because they eliminate the necessity of moving in Kellys, rotary tables or other heavy equipment for light or medium short-time rotary work and because they eliminate the inefficiency and even danger of rotating strings by hand. Bowen Powered Swivels are sensitive enough for small torque operations like cutting with macaroni or sucker rods, yet sufficiently rugged to do clean-out and milling jobs. They are available in two types for light-duty operations and medium-duty rotary work.

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(For more data on advertised products, use Readers' Service blue cards, last page this issue.)

R. W. Sole has been appointed general superintendent of the Production division of **Arkansas Fuel Oil Corporation** in Shreveport.

R. W. Sole

In his new position Sole will handle all drilling, production and similar field operations of the company. **C. W. Hughes** is manager of the Production division.

Sole has been a member of the Arkansas Fuel Oil organization since 1920 when he became district superintendent in Newark, Ohio. He later served in various capacities in the Production division in Wyoming and Texas.

In 1949 he was appointed assistant superintendent of the AFO Production division. He held this position until his present appointment as general superintendent.

A native of West Virginia, Sole attended both grade school and high school in West Virginia and the University of West Virginia in Morgantown. He has worked in the oil fields continuously since completing his education.

•

James J. Brown and **F. B. Jackson, Jr.**, petroleum engineers; **Neil A. Jackson**, geologist; and **Richard L. Roberts**, consultant, have announced the opening of a drilling and exploration office in the Colcord Building in Oklahoma City.

•

James Helis, assistant regional drilling supervisor of the Oklahoma-Kansas area for **Atlantic Refining Company**, Tulsa, has been appointed to head the newly-organized Production department of **General Drilling Company**, Oklahoma City. He is moving from Tulsa to Chickasha to make his headquarters.

•

George F. Getty, II, vice president and director of Spartan Aircraft Company, has been named a director of the **Pacific Western Oil Corporation.** He is also a director of Skelly Oil Company, Mission Corporation and the Admiral State Bank.

•

Glen M. Ruby, geologist, has announced the removal of his office from the Kearns Building to the Newhouse Building in Salt Lake City, Utah.

•

Alec Crowell has been employed as petroleum consultant by **Oil Northwest, Incorporated.** He will be in the corporation's general offices in Helena, Mont. Crowell, recently resigned director-petroleum engineer of the Montana Oil and Gas Conservation Commission, will devote a fourth of his time to Oil Northwest, Incorporated, and the rest to the practice of professional petroleum engineering.

•

Sohio Petroleum Company has announced the transfer of **Bernard A. Taylor** to Casper, Wyo., as district geologist. **R. P. Swirczynski** resigned to accept another position. Taylor joined Sohio in 1946 and in May, 1952, was promoted to Houston district geologist.

•

F. N. Bosco, consulting geologist and professional engineer, has announced his availability for geological service to the independent producer and engineering service to the uranium explorer. His office is in Denver.

For Easy Pipe Threading 2½" to 4"... it's the 4P

RIDGID

RIDGID 4P is easy to carry, easy to put on pipe

Balanced loop handles make it a cinch to carry and swing up on a pipe! Besides, the mistake-proof workholder sets to size before you lift it—only one screw to tighten on pipe. Easy upkeep—drive pinion in oilless bronze bearing; safe enclosed gear. 4 sets of 5 high-speed steel dies, 2½", 3", 3½", 4". Ratchet handle. RIDGID drive shaft available. Save work—buy 4P at your Supply House.

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Adair Service Co. - - - - WE-6497, HU 6-3462
Tuboscope - - - - - - - - JU-0577, MO-4279

MIDLAND
Luccous - - - - - - - - - - - - 4-8471, 4-4320

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Oran W. Brooks has joined the staff of **Hurt Oil Company, Ltd.**, as administrative assistant to the general partner. Brooks formerly was comptroller of Weatherford Oil Tool Company, Inc.

O. W. Brooks

•

R. F. Mathews, Midland, Texas, assistant division geologist for **Continental Oil Company**, has been promoted to division geologist, with headquarters at Wichita Falls, Texas.

He succeeds **H. H. Bybee**, who recently transferred to Midland as division geologist for Conoco.

R. K. Aaker, Roswell, N. M., geologist, has been promoted to district geologist, with headquarters at Midland.

Mathews joined Conoco as a geologist at Wichita Falls in 1948, transferred to Midland in 1952, and was promoted to assistant division geologist at that location in 1953. He is a native of El Paso and received his bachelor's degree in geology in 1948 from the University of Texas.

Aaker became associated with Conoco at Billings, Mont., in 1949 and transferred to Roswell two years later. A native of Hutton, N. D., he received his bachelor's degree in geology in 1949 from the University of North Dakota.

•

Elmer F. Schmidt of Dallas, senior vice president of **Lone Star Gas Company** and its wholly-owned subsidiary, Lone Star Producing Company, has retired from the company. He will open a consulting office in Dallas. Schmidt entered the public utilities field in 1912 when he was employed as a draftsman by Ohio Fuel Company with headquarters at Charleston, W. Va. In 1913 he moved to Toledo, Ohio, as an inventory engineer for Northwestern Ohio Natural Gas Company. He accepted a similar position with Fayette County Gas Company of Uniontown, Penn., in 1914. Schmidt returned to Ohio in 1915 as surveyor and gas measurement engineer with Ohio Fuel Supply Company. In 1917 Schmidt went to Lone Star Gas Company to make a survey of oil and gas fields in Texas. He became an official member of the Lone Star family in 1918 when he was named gas measurement superintendent. Schmidt served as chief engineer, general superintendent and later vice president—production and transmission. He became a member of the board of directors in 1935.

•

Time Petroleum Company of Wichita, Kansas, has announced the appointment of **R. J. Schreiner** as geologist-manager of Exploration and Development departments.

•

Monty G. Martin, chief geologist of Southwest Natural Gas Company, has been named chief geologist of the **Texas Gas Transmission Company** with headquarters at Shreveport. Martin was with The Carter Oil Company before joining Southwest Natural Gas Company.

DEATHS

Stephen R. Nuhfer, retired drilling contractor and independent producer, died April 13.

•

Charles R. Crane II, 61, vice president and director of Crane Company, died May 8 at his home in Chicago. A grandson of the company's founder, Crane was associated with the firm for 46 years.

•

Don L. Carroll, 52, died March 6 in Bethesda, Md. He had recently been in Tel Aviv, Israel, as chief of Minerals Division of Technical Cooperation Administration. Carroll served as field and laboratory assistant, University of Chicago; associate geologist, Illinois Geological Survey; Gulf Coast and international editor of the *Oil Weekly*, Houston; principal geologist, U. S. Geological Survey; and special assistant to the director, Oil and Gas Division, U. S. Department of the Interior.

•

I. H. Patton, Jr., 69, of Tulsa, president of Arrow Drilling Company, died April 30 in Tulsa. Patton helped organize the old Arrow firm about 1924 and joined the present company as a vice president in 1931 when new owners took over. He later became executive vice president and was named president last March.

•

Harry W. Kelsey, 82, of Tulsa, Okla., retired field superintendent for the old Midco Oil Company, died June 6, after a brief illness. He was born in Casey, Iowa, and went to Tulsa about 45 years ago.

Edgar F. Schaefer, 58, president of Gardner-Denver Company and widely known as an industrial leader, died in Quincy, Ill., May 2. Schaefer joined Gardner-Denver in 1919. He was promoted to export manager, assistant sales manager, vice president-sales, member of the board, executive vice president and became president in 1947.

•

Sylvester Yunker, official representative of the Governor of Kentucky to the Interstate Oil Compact Commission since 1948, died April 28. Yunker was an independent oil operator of Owensboro, Ky.

•

Steele Bruce White, 52, president of the Steele Bruce White Oil Company of Ardmore, Okla., died May 23 from injuries received in an automobile accident while enroute to Independence, Kansas.

•

L. D. Hess, Sr., 65, of Grove, Okla., former president of the American Tank and Construction Company, died May 21.

•

Cyrus C. Robbins, 57, petroleum engineer for Sunray Oil Corporation, Tulsa, died May 21. A resident of Tulsa for 20 years, Robbins worked for The Carter Oil Company before joining Sunray.

•

Clarence R. Edmisten, 58, an oil field construction worker, died May 20 in a Tulsa hospital.

What's Happening

AMONG INDUSTRY ASSOCIATIONS

Pacific Coast Officers Named

Newly-elected officers of the Pacific Coast District, Division of Production, API are, left to right standing, John Van Riper, Continental Oil Company, vice chairman for coastal area; Lot Bowen, Western Gulf Oil Company, chairman of Advisory Committee; I. B. Doyle, Hydril Corporation, assistant treasurer. Seated are Elsie Edmiston of the API, secretary; C. F. Gates, General Petroleum Corporation, chairman of Pacific Coast district; Hugh C. Mays of Crescent Petroleum Company, vice chairman for San Joaquin Valley. Not shown are E. M. Benson, Jr., Richfield Oil Corporation, vice chairman for Los Angeles Basin; Jack Lemley, Standard Oil Company of California, vice chairman for Coalinga-Kettlemen area; and Charles T. Reichert, National Supply Company, treasurer.

10 Members Named To LP-Gas Council

Appointment of ten new members of the National Council for LP-Gas Promotion by the Gas Appliance Manufacturers Association and Natural Gasoline Association of America has been announced by James E. Pew, manager, Natural Gas and Natural Gasoline department, Sun Oil Company, Philadelphia, chairman of the council.

The GAMA representatives, named by Sheldon Coleman, president of the association and president of The Coleman Co., Wichita, Kansas, are F. A. Kaiser, vice president, Detroit-Michigan Stove Co., Detroit; James Donnelly, vice preident, Servel, Inc., Evansville, Ind.; A. B. Ritzenthaler, vice president, The Tappan Stove Co., Mansfield, O.; C. L. Burrows, vice president, The Coleman Co., Wichita, Kansas, and John W. Christensen, manager, promotions, Hamilton Manufacturing Co., Two Rivers, Wis.

NGAA appointees, chosen by its president, Frank Perry, manager, gasoline and chemical division, Cities Service Oil Company, Tulsa, Okla., are John F. Lynch, president, La Gloria Corporation, Corpus Christi, Texas; Leo J. Wilmeth, general sales manager, Shamrock Oil & Gas Corporation, Amarillo, Texas; Joe Miller, coordinator of products, Humble Oil & Refining Co., Houston; G. L. Brennan, vice president, Warren Petroleum Corporation, Tulsa, and E. A. Jamison, manager, LP-Gas sales, Gulf Oil Corporation, Pittsburgh.

The new members were named in keeping with a recent re-apportionment of association representation on the council (formerly known as the National Committee for LP-Gas Promotion) and to fill certain other vacancies. The group directs the National LP-Gas Promotional Program, which is co-sponsored by NGAA, GAMA and the Liquefied Petroleum Gas Association.

University of Michigan Offers Summer Course

The Department of Chemical and Metallurgical Engineering of the University of Michigan College of Engineering will offer an intensive course, "The Design of Distillation and Absorption Equipment" July 12-23. The course, designed for practicing engineers, will provide a working knowledge of fundamental principles and will cover such subjects as tray layout and hydraulics, axeotropic and extractive distillation, vapor liquid equilibrium and tray calculations.

Dr. Roger H. Newton of Badger Manufacturing Company will join Robert R. White and Brymer Williams of the University faculty in presenting the course. Information and registration forms may be obtained from the Department of Chemical and Metallurgical Engineering, 2028 East Engineering Building, Ann Arbor, Mich.

Oil Producers Association Announces New Officers

E. E. Pyles, vice president, Monterey Oil Company, has been re-elected president of the San Joaquin Valley Oil Producers Association. Also re-elected as vice presidents were Lowell W. Saunders, board chairman of Intex Oil Company and H. F. Owen, general manager and field superintendent of Berry and Ewing. Charles O. Premo was re-elected secretary.

In addition to the above named persons, the board of directors consists of H. R. Pauley, L. L. Aubert, R. E. McCarthy, R. E. Gignoux, E. C. Reid, J. B. Spellacy, L. A. Cranson, Ross McCollum, J. M. Feldman, F. W. Borden, and H. D. Campbell.

Mid-Continent District API Names Neslage Chairman

Fred Neslage of the West Pampa Repressuring Association, Pampa, Texas, was elected new chairman of the Mid-Continent District, Division of Production, American Petroleum Institute.

The district chairman was chosen at a group session of the API's spring meeting in the Biltmore Hotel attended by more than 1000 oil men from Oklahoma, Kansas and the Texas Panhandle.

District vice chairmen elected are W. W. Wylie, Schlumberger Well Surveying Company, Pauls Valley, Okla., vice chairman for the Golden Trend area; LeRoy Tucker, Rocket Oil Company, Duncan, Okla., vice chairman for southwestern Oklahoma; Carl Most, Sinclair Oil and Gas Company, Drumright, Okla., vice chairman for the Drumright-Perry area; J. N. Perkins, Phillips Petroleum Company, Amarillo, Texas, vice chairman for the Texas Panhandle; Paul C. Cottrell, The Carter Oil Company, Great Bend, Kansas, vice chairman for Kansas; and I. A. Barr, Gulf Oil Corporation, Seminole, vice chairman for the Seminole-Oklahoma City area.

C. A. Husted, C. A. Husted Contractors, Pampa, Texas, was chosen secretary-treasurer. New chairman of the advisory committee is Jack Abernathy, Big Chief Drilling Company, Oklahoma City, who is succeeded by Neslage as district chairman.

William Strang, Dallas, is director of the API's Division of Production.

Have YOU tried the Revolutionary New

DROVIL TUBING SWAB?

Here's the swab that's setting new performance records throughout the oil industry . . . lifting *bigger* loads and giving *more* runs per dollar — with *no* damage to costly tubing strings.

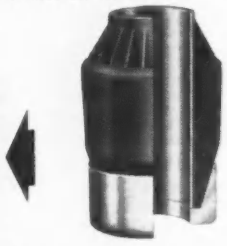
Advanced Features!

HOLLOW POCKETS molded into rubber swab cups fill with fluid, flexing swab lip against tubing for a tight seal. The Drovil lifts a bigger load every trip!

RUBBER RIBS, integral with swab body, hold swab lip concentric, support load, assure long swab life.

NO METAL touches the tubing surface — therefore no metal to wear out and fall into the well, or to stick the swab.

ONE TYPE handles light, medium and heavy loads. No need to change cups for varying loads. Simplifies inventories, cuts costs.



Field reports from all parts of the oil industry show Drovils outperform, outlast conventional tubing swabs. If you think all tubing swabs are pretty much the same, try a Drovil on your next swabbing job and compare performance—compare costs —compare results!

Full range of sizes. Send for helpful data sheet that gives construction details and specifications.

Available Through Leading Supply Stores — or Write Direct!

The Drovil is ideal for plastic as well as conventional tubing!

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University of Texas Offers Drilling Fluids Course

A special graduate course on The Composition and Properties of Oil Well Drilling Fluids will be offered under the Institute for Advanced Engineering at the University of Texas between August 26 and September 15, 1954.

Topics to be covered include testing procedures and specifications of muds and materials, composition of bentonite and clays, properties of bentonite and clay in aqueous media, fluid loss reducing agents, viscosity reducing agents, rheological properties of mud, filtration properties of mud, fresh water and salt water muds, calcium treated muds, oil emulsion muds, oil base muds, high temperature solidification, electric logging and drilling muds, lost circulation and casing programs for deep wells.

Walter F. Rogers, chief chemist, Gulf Oil Corporation's Houston Production division, will be the principal lecturer. Professor H. H. Power of the Department of Petroleum Engineering and six experts from industry will take part in the program.

Prerequisites will be a B.S. in engineering, or a B.S. or B.A. in chemistry, geology, or other acceptable science curriculum, including at least one year of active mud handling or the equivalent. Maximum enrollment will be 50. The fees will be $125 per course for both graduate students and auditors.

For further information and enrollment write to W. R. Woolrich, Dean, College of Engineering, The University of Texas, Austin, Texas.

Oil and Gas Association Names North Texas Officers

D. C. Norwood, Norwood Drilling Co., Wichita Falls, Texas, has been elected president of the North Texas Oil and Gas Association, succeeding Eugene B. Clark.

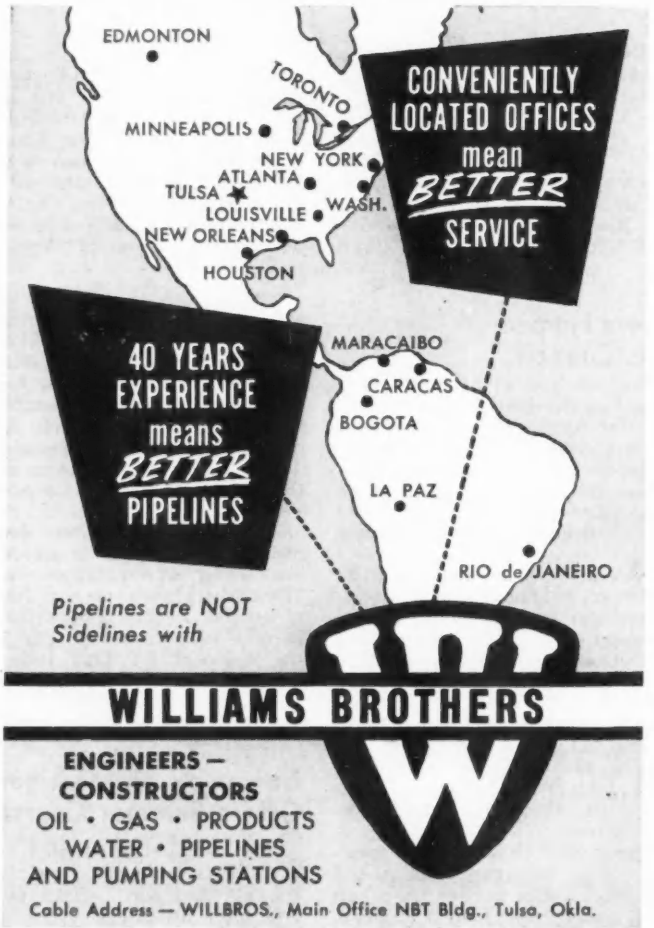
Other officers are Charles Prothro, Perkins-Prothro, reelected first vice president; Wayne O. Watts, Walsh and Watts, second vice president. Members of the board of directors include Jack Austin, Ralph Bullington, Bobby Burns, Jr., R. H. Coffee, James A. Cullum, Frank M. Denman, Jr., Roy Dickinson, H. W. Fillmore, Ralph Hines, Rhea Howard, Frank Hunter, John Kay, Rufus King, Roy LeBus, Donald May, A. G. McCarver, John McMahon, F. E. Melot, Maynard Stephens, Clifford Tinsley and Curt Weaver, all of Wichita Falls, and John Biggs of Vernon and James V. McCall of Nocona, Texas.

AAODC Establishes Regional Chapter

Representatives of drilling firms in the West Central Texas area met recently at Abilene, Texas, to organize the fifteenth regional chapter of the American Association of Oilwell Drilling Contractors.

AAODC officers attending the meeting were Karl L. Kellogg, Compton, Calif., president; Brad Mills, Dallas, executive vice president; and W. L. McClusky, Dallas, secretary.

Officers of the chapter for 1954 elected were B. F. Gilchrist, Gilchrist Drilling



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It takes money . . . big money to find and produce oil. Oil men know that the Republic is about the best place in Texas to get it.

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Leases are the beginning of the business end of 4,171,700 barrels a day of southwestern oil production. Financing the rest of the business of oil is what makes an "Oil Bank".

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Catawissa PERFECT SEAL Unions

HOT FORGED from solid, rectangular steel bars, designed and produced for dependable, long-life service under the severest piping conditions!

A TYPE FOR EVERY USE!
FOR ALL PRESSURES!
FOR ALL TEMPERATURES!

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UNIONS
Available with screwed or socket weld ends. 3000-lb. sizes ⅛" to 3"; 6000-lb. sizes ⅛" to 2".

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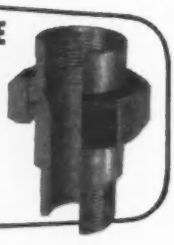
With screwed or socket weld ends. 3000-lb. and 6000-lb. service.

MALE & FEMALE UNIONS
With steel-to-steel, bronze-to-steel, stainless steel-to-steel or orifice seats. 3000-lb. service only.



Standard & Double Extra Heavy
LUG NUT UNIONS
Hammer-type for quick opening and quick closing.

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showing the complete Catawissa line of Perfect Seal Products

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Company, Abilene, chairman; George M. Straughn, Lauderdale and Straughn, Abilene, vice chairman; George M. Straughn, Lauderdale and Straughn, Abilene, vice chairman; and George D. Hunter, General Geophysical Company, Abilene, secretary-treasurer.

Desk and Derrick Officers Elected in Los Angeles

Katherine Livada, division chief accountant and office manager for Tretolite Company of California Division, was elected president of the Los Angeles Desk and Derrick Club. Mrs. Livada was first vice president of the group in 1952-53 and during the 1953 national convention in Denver, was a member of the resolutions committee.

Other officers elected for 1954-55 are Lucille Lyle, Bankline Oil Company, first vice president; Helen Hogan, Signal Oil and Gas Company, second vice president; Faye M. Jordan, R. J. Eiche & Associates, Inc., recording secretary; and Lorene Peterson, Union Oil Company of California, treasurer.

Elected for a two-year term as directors were Margaret Martin, Baker Oil Tools, Inc., and Betty Meagher, Fluor Corp., Ltd.

Katharine Ferguson Heads Delaware Valley D & D Club

Katharine M. Ferguson of Mount Airy, Philadelphia, has assumed the presidency of the William Penn Desk and Derrick Club, composed of 250 women employed in 19 companies of the petroleum and allied industries in the Delaware Valley. Miss Ferguson is secretary to the general counsel and an assistant secretary of the Atlantic Refining Company.

Others elected were Irene F. Smith, Esso Standard Oil Company, vice president—president-elect; Helen C. Glenn, Cities Service Oil Company, treasurer; M. Virginia Puckey, Atlantic Refining Company, corresponding secretary; Marion E. Hartman, Socony-Vacuum Oil Company, recording secretary. Anna E. Litz, Major Petroleum Company, and Mrs. Beatrice D. Stillman, Gulf Oil Corporation, were elected to the board of directors.

AAODC Present Awards To Three Professors

The American Association of Oilwell Drilling Contractors recently presented honorariums to three professors in the petroleum engineering field for their work in interesting students in careers in oilwell drilling.

The awards went to Harold A. Bohneberg, Colorado School of Mines; Benjamin C. Craft, Louisiana State University; and J. W. Amyx, Texas A & M College.

Geological Society Officers Elected in Oklahoma City

W. M. (Bill) Decker, Cities Service Oil Company, has been elected president of the Oklahoma City Geological Society. Other officers named are B. Osborne Prescott, Shell Oil Company, vice president; Cliff Branan, Kirkpatrick Oil, secretary; and Edward Barrett, Continental Oil Company, treasurer. Mrs. Mildred V. Frizzell continues as editor of *The Shale Shaker*.

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RATIGAN
#212
BLOWOUT PREVENTER

The No. 212 is designed for maximum safety and convenience in operation. Manufactured of high-pressure electric steel with 3000 lb. capacity, yet comparatively light in weight. It can also be used for swabbing or running rods in wells that head, or flow, in course of operations. The Ratigan No. 212 Blowout Preventer is equipped with the latest type retractable rubbers . . . simply unscrew the plugs at each end to change. The "212" is manufactured in 2", 2½" and 3" sizes. The 2" and 2½" sizes are supplied both plain and upset and can be furnished in male or female or double female. The 3" size is supplied in male and female only.

Sold through leading supply stores everywhere.

J. P. RATIGAN, Inc.
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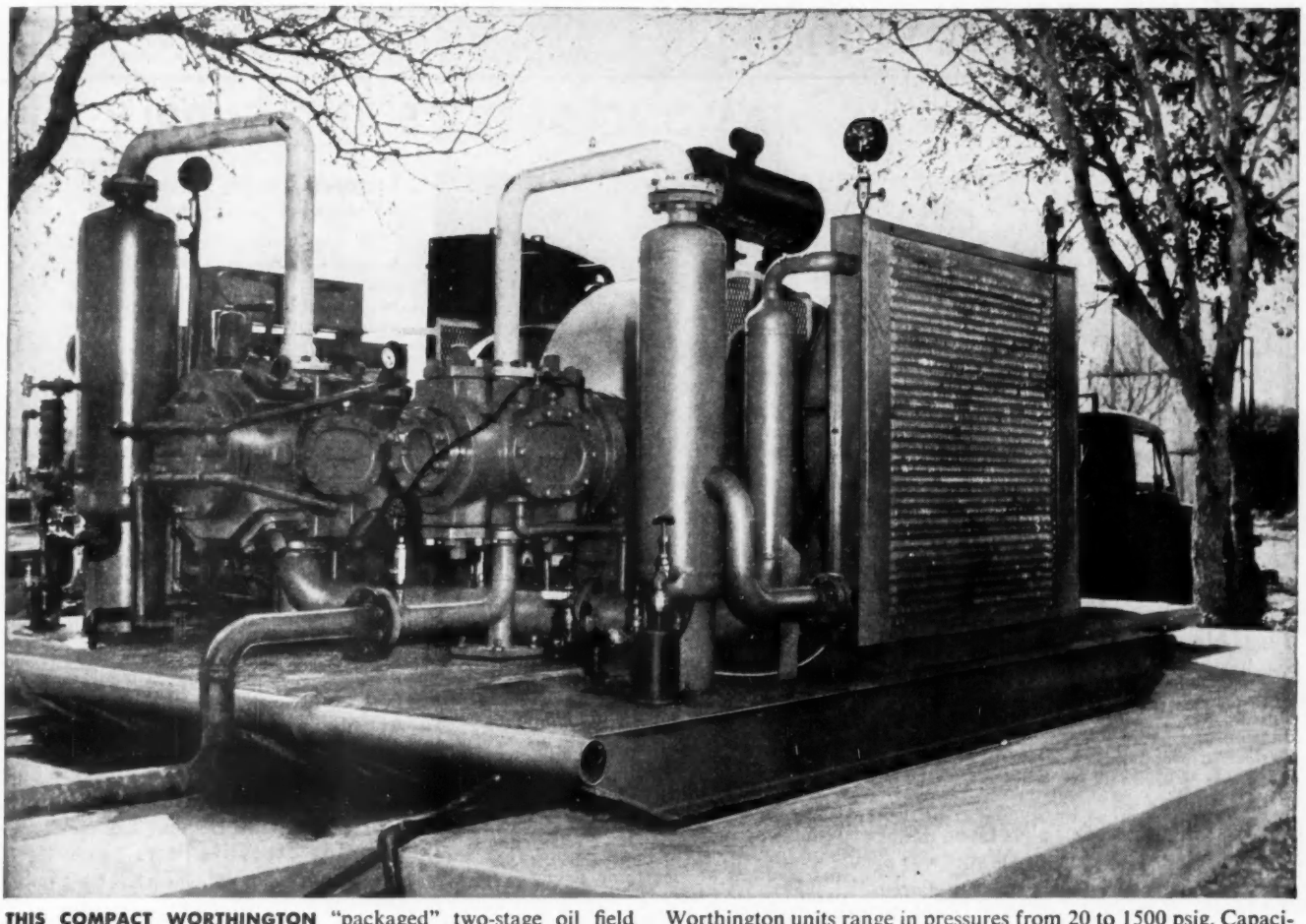
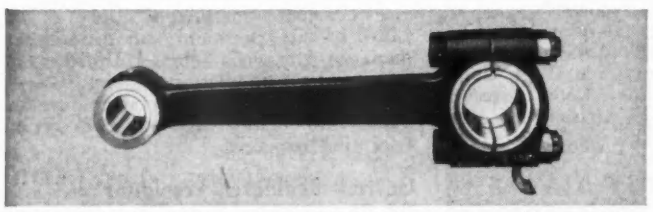
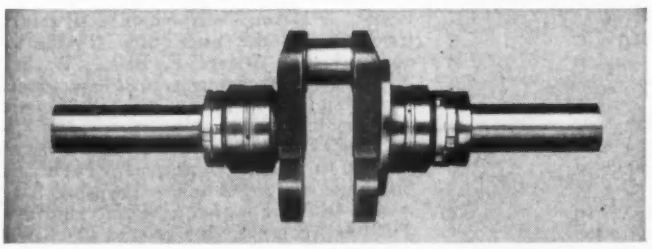


THIS COMPACT WORTHINGTON "packaged" two-stage oil field compressor is working in an oil field at Refugio, Texas. These Worthington units range in pressures from 20 to 1500 psig. Capacities range from 0.1 to 9.5 million cubic feet.



FORGED STEEL, SEMI-MARINE CONNECTING ROD, with precision bored crosshead pin bearing. The bearing is grooved for oil passage and locked in position — renewable at small expense.



COUNTER-BALANCED, ONE-PIECE, FORGED STEEL CRANKSHAFT with dual counterweights to eliminate vibration, and sturdy, oversize shaft extensions for mounting driving sheave and flywheel.

Here's what oil men mean by a *rugged* compressor

Take a long look at Worthington's new "packaged" oil field compressor. Built to keep going through the roughest kind of duty, this powerful unit has won the acclaim of oil men everywhere.

Shown at the left are just two of the features responsible for the reputation these long-lived compressors are making for themselves in gas boosting, gas lift, well flowing, transmission, and repressuring jobs throughout the petroleum industry.

Find out for yourself about the modern, self-contained Worthington units. They're all equipped with our exclusive Feather* Valve — the lightest, tightest, most efficient valve made. See your local oil field distributor or write to Worthington Corporation, Section PC.4.3, Harrison, New Jersey.

WORTHINGTON* *Reg. U.S. Pat. Off.*

PC.4.3

BUY THESE WORTHINGTON STANDARD PRODUCTS FROM YOUR LOCAL DISTRIBUTOR

Compressors • Pumps • Multi-V-Drives • Allspeed Drives

What's Happening

AMONG SERVICE AND SUPPLY MEN

Ten New Sales Managers Named

New McCullough Tool Company Eastern Division district sales managers are, left to right, standing: E. H. Lain, Ross Harris, John W. Watson, Joseph Abney, C. L. Bonds and W. H. Wyman. Seated are Robin Knight, M. L. Van Wagner, assistant Eastern division manager; R. W. Smith, Eastern division sales manager; J. A. Williams, assistant Eastern division sales manager; C. W. Hamilton and T. H. Farmer. Not shown in the picture is William Perkins.

W. H. (Bill) Womble Takes Over Gulfco Offices in Casper, Wyo.

W. H. (Bill) Womble is now in charge of the Gulf Coast Machine & Supply Company sales office and warehouse in Casper, Wyo. Womble took over his duties on July 1 after being transferred from the company's Wichita Falls, Texas, office. Womble has been with Gulfco 15 months and is a specialist on wellhead equipment.

Gulf Coast Machine & Supply Company distributes forged steel wellhead equipment and allied products.

Lane-Wells Fills Positions In Mid-Continent Division

Donovan S. McKee has been appointed acting division operating engineer of the Mid-Continent division of Lane-Wells Company at Oklahoma City. He replaces R. W. Warkentin who resigned.

Allan W. Hardy, formerly radioactivity operator, has been appointed district sales engineer trainee of the Kansas District at Great Bend, Kansas. Kenneth W. Simmons, formerly a radioactivity operator at Oklahoma City, has been made a district sales engineer trainee at Bartlesville, Okla.

Hamer Oil Tool Changes Name to Hamer Valves, Inc.

A change of the company name from Hamer Oil Tool Company to Hamer Valves, Inc., has been announced. Leland Hamer, president, stated that the change was made to more clearly identify the company with the products it manufactures.

Hamer Valves, Inc. is located at 2919 Gardenia Avenue, Long Beach 6, Calif.

Fairbanks, Morse & Company Forms New Electronics Division

Fairbanks, Morse & Company, Chicago manufacturers, has announced the organization of a new Electronics division. This division will be responsible for research, development, application engineering, and manufacture of electronic devices and apparatus used in conjunction with various Fairbanks-Morse products.

McCullough Tool Names Lutey Division Public Relations Head

Jack Lutey has been appointed Eastern Division public relations director for McCullough Tool Company. Lutey assumes the position formerly held by Robert W. Smith, who several months ago became Eastern division sales manager.

Jack Lutey

Lutey was a special agent for the Federal Bureau of Investigation for eight years. In 1948 he turned to public relations work, being active in several Houston concerns before joining McCullough Tool Company in 1953. He worked in the McCullough service department at Houston and later on in the sales department as a part of the intensive McCullough trainee program before assuming his new position.

Estes Named General Manager Of Oil Well Survey Instrument

Harry E. Estes has resigned as executive assistant to the president of A-1 Bit & Tool Company, Houston, to accept the position of general manager of Oil Well Survey Instrument Company. He has also been elected secretary-treasurer of the Quick-Fill Corporation, a new concern doing business at the same location.

Estes had been with A-1 for seven years, prior to which he was employed by Reed Roller Bit Company.

Rockwell Awards Service Pins At Midwest Service Meeting

M. D. Gilbert, Kansas City district sales manager of Rockwell Manufacturing Company's Meter and Valve division, and C. K. Madison, Midwest regional sales manager, received 30-year and 25-year service pins respectively at a recent Midwest sales meeting in Tulsa.

Miss Ruth Hickman, sales correspondent in the regional office, was to be awarded a 25-year pin in a later ceremony. At the same time, George West and Warner Shane, Tulsa district repairmen, will receive 15 and 10-year service buttons, respectively.

Those who received 20-year buttons at the recent meeting included R. R. Bush, Tulsa district manager; H. M. Logan, sales engineer in the Tulsa district; and W. R. McLaughlin, supervisor of the Dallas office.

Fifteen-year buttons: T. I. Stacy, sales engineer, and A. E. Hugel, office manager, both of Houston; J. W. Whiteside, office manager, and C. T. Guffey, sales engineer, of Kansas City.

Ten-year button: R. B. Rugeley, supervisor of the Houston office.

Universal Atlas Cement Co. Fills Top Executive Posts

Election of three executives and the appointment of another, all to higher office with Universal Atlas Cement Company, have been announced.

Directors of the company elected Fred T. Wiggins to the newly created office of vice president—commercial; James C. McClure to vice president and general sales manager; Henry C. Schmielau to the additional office of vice president. Mac C. Hull was appointed assistant to president and W. Owen Lawrence was made general operating manager.

Garrick Reelected President Of Cherokee Laboratories

At the second annual meeting of Cherokee Laboratories, Inc., Tulsa, David A. Garrick was reelected president and Robert D. Denny was renamed secretary-treasurer. At the same time it was announced that George F. Bauer, Jr., had disposed of his interest in the company and resigned as vice president and director.

Cherokee Laboratories, Inc., was organized in 1952 to manufacture and distribute on an exclusive licensing basis, a new lost circulation material known as Tuf-Plug, composed of ground black walnut shells, and developed by Stanolind Oil and Gas Company's research laboratory. Since then Garrick has secured three additional exclusive licenses from Stanolind covering Tem-Plug, an oil-soluble lost-circulation material; Cavern-Plug, prism-shaped blocks of weighted cement designed to form barriers against lost circulation in large cavities, and Tuf-Prop, a propping agent used in hydraulic fracturing operations.

Cherokee Laboratories, Inc., maintains sales offices in New Orleans, La.; Midland, Texas; Hobbs, N. M.; Casper, Wyo., and Oklahoma City, and has distributors in Canada and South America.

Williamson in Sales Post for Allis-Chalmers Tractor Division

Ray E. Williamson has been named assistant industrial sales manager at the Memphis branch of the Tractor division, Allis-Chalmers Manufacturing Company. Williamson has been in industrial sales for Allis-Chalmers since 1947 and has been on the sales force at the Dallas branch since 1951. He served in the Seabees from 1943 to 1946. He is a native of Nebraska and a graduate of that state's university.

R. E. Williamson

Lane-Wells Announces Changes In Supervisory Personnel

Lane-Wells has completed several supervisory and sales personnel changes. I. W. Brown has been named operator in charge of the Ruston, La. truck station. D. P. Duncan, formerly district sales engineer at Houma, La. has been transferred to New Iberia in the same position. B. N. Stroud, formerly district sales engineer trainee at New Iberia, has been transferred to Houma.

Steel Erection Started for New Clark Equipment Company Plant

Steel erection has begun on the new manufacturing plant of Clark Equipment Company at Benton Harbor, Mich. The new building will be used as a manufacturing plant for a new line of tractor shovels and power shovels now made in the company's present Benton Harbor plant. The plant is due to be in operation by the end of the year.

Seismograph Service Corporation Offering New Exploration Service

A new exploration service designed to provide detailed information about the vertical velocity of sound-energy travel through subsurface formations is available through Seismograph Service Corporation.

Invented and developed by Magnolia Petroleum Company, the "continuous velocity logging" is being offered to the industry out of their Midland, Texas, division, according to G. H. Westby, Tulsa, Seismograph Service president.

Geophysical Service Appoints Vetter Assistant Vice President

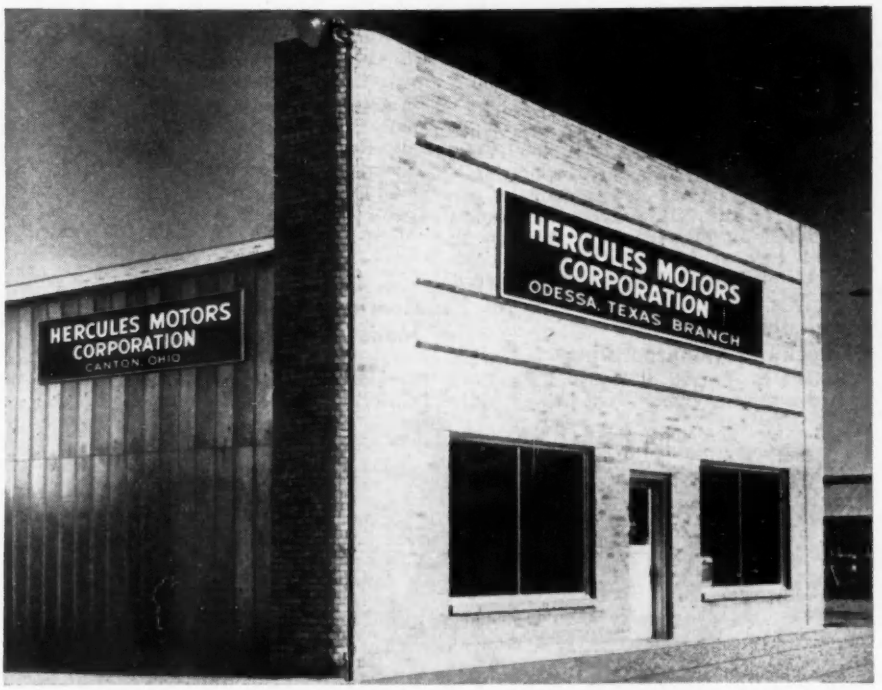
E. O. Vetter has been appointed assistant vice president, administration, for Geophysical Service Inc. He heads a newly organized administrative division set up to coordinate GSI staff functions and to consolidate activities of the company's Control and Equipment departments.

Vetter joined the staff of GSI as controller in September, 1952. He holds a B.S. degree in mechanical engineering from the Massachusetts Institute of Technology.

R. S. Skinner Advanced In National Supply Company

R. S. Skinner has been appointed sales representative in Philadelphia for the Spang-Chalfant division of The National Supply Company.

Skinner, a graduate of the University of California at Los Angeles, joined National Supply in 1937. He has served in various capacities in both the oil field sales and Spang-Chalfant divisions of the company and was previously located in Torrance, Los Angeles, and San Francisco, Calif., St. Louis, and Denver.



Hercules Moves Into New Home at Odessa

Hercules Motors Corporation has moved its Odessa, Texas, branch into new quarters. Officials of the company credited the move to increased demand for Hercules engines and power units in oil field service. The improved and enlarged facilities include a sales room, enlarged parts department, and more adequate engine servicing facilities. The Odessa branch is under the supervision of William Humphrey, Mid-Continent oil field manager. C. J. McCulloch is branch manager.

Honors for Westinghouse

For paying a cash dividend to its stockholders every year for 80 consecutive years, Westinghouse Air Brake Company recently was honored by the New York Stock Exchange. Richard M. Crooks (left), chairman of the Exchange, greets Edward O. Boshell (center), chairman and president of Westinghouse Air Brake Company, and John W. Sargent, whose family has held stock in the company since 1870, at a luncheon in New York commemorating the company's 80-year dividend record.

Ray Loper Joins Staff Of The Western Company

Ray Loper, has joined the staff of The Western Company, as operations training coordinator.

Loper has worked closely with Western during the past three years on a consulting basis. He received his degree in petroleum engineering from Oklahoma University. After teaching at Oklahoma University. for two years, he went to Louisiana State University as professor of petroleum engineering. He has resigned from the LSU staff after 4½ years to accept the position with The Western Company.

Ray Loper

Loper will make his headquarters in Western's Midland office.

Cooper-Bessemer Metallurgist Receives Seaman Gold Medal

Thomas E. Eagan, chief metallurgist of The Cooper-Bessemer Corporation, has been awarded the Joseph S. Seaman Gold Medal by the American Foundrymen's Society. The award was presented to Eagan for his "outstanding work in the development and dissemination of engineering data on the production and utilization of alloy cast irons."

Formal presentation of the award was made at the annual banquet of the Society during its 58th Annual Convention at Cleveland, Ohio.

McCullough Tool Names Matson Sales Engineer

W. J. Matson has been appointed sales engineer for McCullough Tool Company assigned to the Magnolia, Ark. branch.

Matson's previous oil field experience includes eight years with Woodley Petroleum, six years with Cavins Corporation—two of those years as district manager. He was also in the oil well service business for himself for one year. For the past 12 months he has been with McCullough Tool Company as an operating engineer.

Farrell Joins Staff Of Rockwell Manufacturing

Robert M. Farrell of Houston, has been named a sales engineer for Rockwell Manufacturing Company's Meter and Valve Division. Farrell will specialize primarily in sales of Rockwell-produced Nordstrom valves in the Texas area.

A salesman with Oil Center Tool Company for the past two years, Farrell has also done sales work for Ateco Equipment Company and served as an engineer with Halliburton Oil Well Cementing Company. He attended Kansas State College at Manhattan, Kan., from 1933 through 1936.

Continental Supply Makes Personnel Changes

The Continental Supply Company has announced two changes in personnel. W. C. True, former store manager in Abilene, Texas, has been moved to the position of city salesman in that city. B. E. Wright, formerly of the Wichita Falls, Texas, store, is the new store manager in Abilene.

Fluid Packed Pump Company Names Lorentzen to Post

R. A. Lorentzen has been appointed supervisor of the company's catalog and pricing section of the Sales department of Fluid Packed Pump Company.

R. A. Lorentzen

Lorentzen joined Fluid Packed Pump Company in 1937 as plant worker. He served as shop inspector for three years and in 1940 joined the Engineering Department. Lorentzen's knowledge of Fluid Packed Pump Company products gained through many years in the Engineering department qualifies him for his new duties.

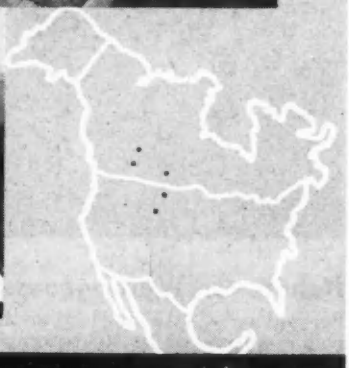
chem lab

5 LABORATORIES TO SERVE YOU IN THE ROCKY MOUNTAIN AREA

CASPER • GLENDIVE • EDMONTON • CALGARY • REGINA

Each of Chem Labs' five conveniently located laboratories is set up with equipment and services especially for the area it serves and its personnel has specialized experience on the problems peculiar to that region.

portions of laboratory at Edmonton, showing Full Diameter Corestudy and Water Analysis apparatus.



CHEMICAL & GEOLOGICAL LABORATORIES

CHEMICAL, ENGINEERING AND GEOLOGICAL SERVICES

O. A. Johnson

LeRoy Lyles

American Iron and Machine Adds Two to Sales Force

Two additions have been made to the sales force of the American Iron and Machine Works.

O. A. (Jack) Johnson has recently been sent to the West Texas area as sales representative. Before coming to American Iron, Johnson represented Security Engineering Division, Dresser Industries and The Pure Oil Company. His headquarters will be at Odessa, Texas.

LeRoy Lyles will represent American Iron in the Southwest Louisiana territory and will reside in New Iberia. Lyles was formerly with the Tuboscope Company in the Louisiana and Oklahoma areas.

Oil Center Tool Company Names McDow Sales Representative

Harry N. McDow has been appointed a sales representative for Oil Center Tool Company. McDow's headquarters will be in Denver.

Harry N. McDow

McDow was formerly a salesman for Gulf Supply Company and Rockwell Manufacturing Company in Corpus Christi. He is a native of Brownwood and attended Texas A&M College.

SECOND NATIONAL service... a sure pay-out!

Each year more and more oil and gas men recognize the value of Second National's specialized banking service. Second National's Oil and Gas Department is geared to the needs of the petroleum industry. Petroleum engineers and geologists compose the staff of Second National's Oil and Gas Department. They are available for counsel at all times for Second National customers.

A clearinghouse of oil and gas information is maintained. Oil and gas reports, journals, records of wells drilled, and statistical files on oil and gas operations are kept up to the minute. Complete sets of field maps, county maps, and other geological information valuable to producers and investors are available.

Make plans now to see Second National's Oil and Gas Department. They are genuinely interested in being of service to you.

47 Years of Service to the Southwest

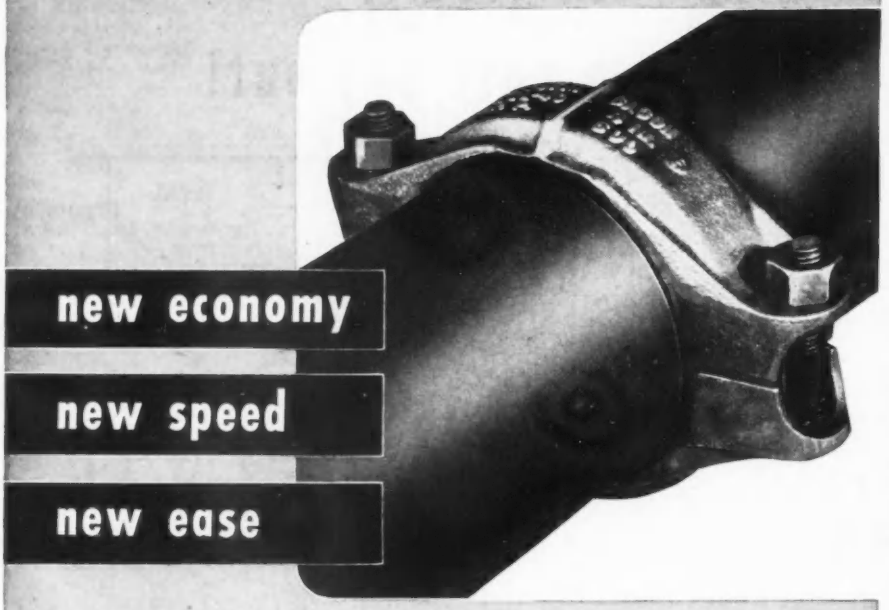
the SECOND NATIONAL Bank of Houston

MAIN at RUSK

CAPITAL AND SURPLUS 20 MILLION DOLLARS

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

Now! Couple grooved pipe with



new economy

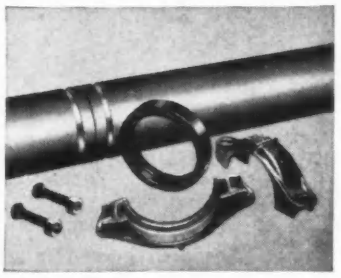
new speed

new ease

new GRUVAJOINTS

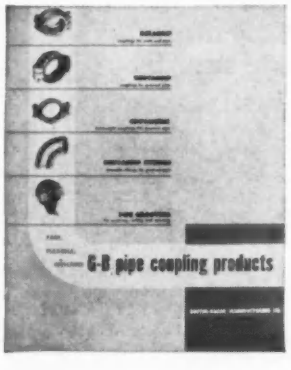
lightweight couplings for grooved pipe

GRUVAJOINTS — for grooved pipe systems carrying pressures up to 500 psi — cost considerably less than ordinary grooved pipe couplings. You get substantial freight savings, too, because **GRUVAJOINTS** weigh up to 45% less than conventional couplings.



Light and trim, **GRUVAJOINTS** are easy to apply and remove; easy to store; can be used over and over. They are made of malleable iron for 2", 3" and 4" pipe — protected with green rust inhibitor.

The **GRUVAJOINT** sealing gasket is interchangeable with those in **GRUVAGRIPS** (standard weight grooved pipe couplings). **GRUVAJOINTS** couple perfectly with **GRUVAGRIP FITTINGS.**



See new **GRUVAJOINTS** this week at your supply store!

FREE FOLDER

Write today for illustrated folder describing **GRUVAJOINTS** and other G-B pipe coupling products — **GRUVAGRIPS, GRUVAGRIP FITTINGS** and **ROLAGRIPS** (for plain end pipe). Ask for folder CCF.

Gustin-Bacon Manufacturing Company

210 West Tenth Street Kansas City 6, Missouri

Ray R. Noland

Louis Morgan

Black, Sivalls & Bryson Opens Branches, Names Managers

Oilfield Sales and Service Division of Black, Sivalls & Bryson, Inc. announces the appointment of two new managers of recently opened branches at Harvey and Lake Charles, La.

Ray R. Noland, former serviceman at Houston, has been appointed manager of the new Harvey branch and Louis Morgan, formerly at Lafayette, has been named manager of the Lake Charles branch.

National Supply Company President Named Commerce Advisor

A. W. McKinney, Pittsburgh, president of The National Supply Company, and past president of Petroleum Equipment Suppliers Association, was sworn in as the Department of Commerce advisor for the Agricultural, Construction, Mining and Oil Field Equipment division of the Business and Defense Services Administration.

A. W. McKinney

McKinney will confer with high level Department of Commerce officials on problems and government activities in connection with that industry. His services will be of an advisory nature and are part of the general plan of better preparedness in the event of war emergency.

Halliburton Oil Well Cementing Elects G. D. McEnroe Treasurer

Election of G. D. McEnroe as treasurer of Halliburton Oil Well Cementing Company has been announced. The new treasurer fills the vacancy created by the death of Hugh H. Leonard.

McEnroe joined Halliburton in 1940 as a tax accountant at Halliburton's Duncan, Okla., headquarters. He then filled the posts as chief tax accountant and assistant treasurer. McEnroe is in charge of Taxes, Credit, Traffic and Treasury departments for Halliburton.

Sam A. Tener Joins Staff Of Hercules Tool Company

Sam A. Tener has joined the staff of Hercules Tool Company. He will serve as sales representative in Oklahoma, the Texas Panhandle and Wichita Falls, Texas, area. He was formerly with Robinson Packer Company.

K. C. Johnson

J. C. Hesler

Industrial Filter and Pump Adds To Engineering and Field Staffs

Industrial Filter & Pump Manufacturing Company has transferred K. C. Johnson from its home office to the Pacific coast as regional field engineer. He will work out of the company's offices in Los Angeles and San Francisco. Johnson joined Industrial in 1949 and most recently was assistant chief engineer. He is a member of the executive committee of the Western Society of Engineers.

J. C. Hesler has joined the engineering staff of Industrial as head of the expanded water and waste treatment division. Hesler comes to Industrial with 15 year's experience in the water and wastes treatment field as research chemist, chief chemist, project and design engineer and in field engineering work.

D+B Division, Emsco Manufacturing To Handle Otis Two-Zone Pumps

Otis Pressure Control, Inc., and the D+B Division of Emsco Manufacturing Company, have concluded an exclusive agreement by which D+B is authorized to manufacture, sell and service the Otis Two-Zone Pump.

All engineering and manufacturing operations will be performed at the D+B plant in Garland, Texas. Installation, service and repair of the pump will be performed by trained D+B service men. This includes pumps in service and those to be installed.

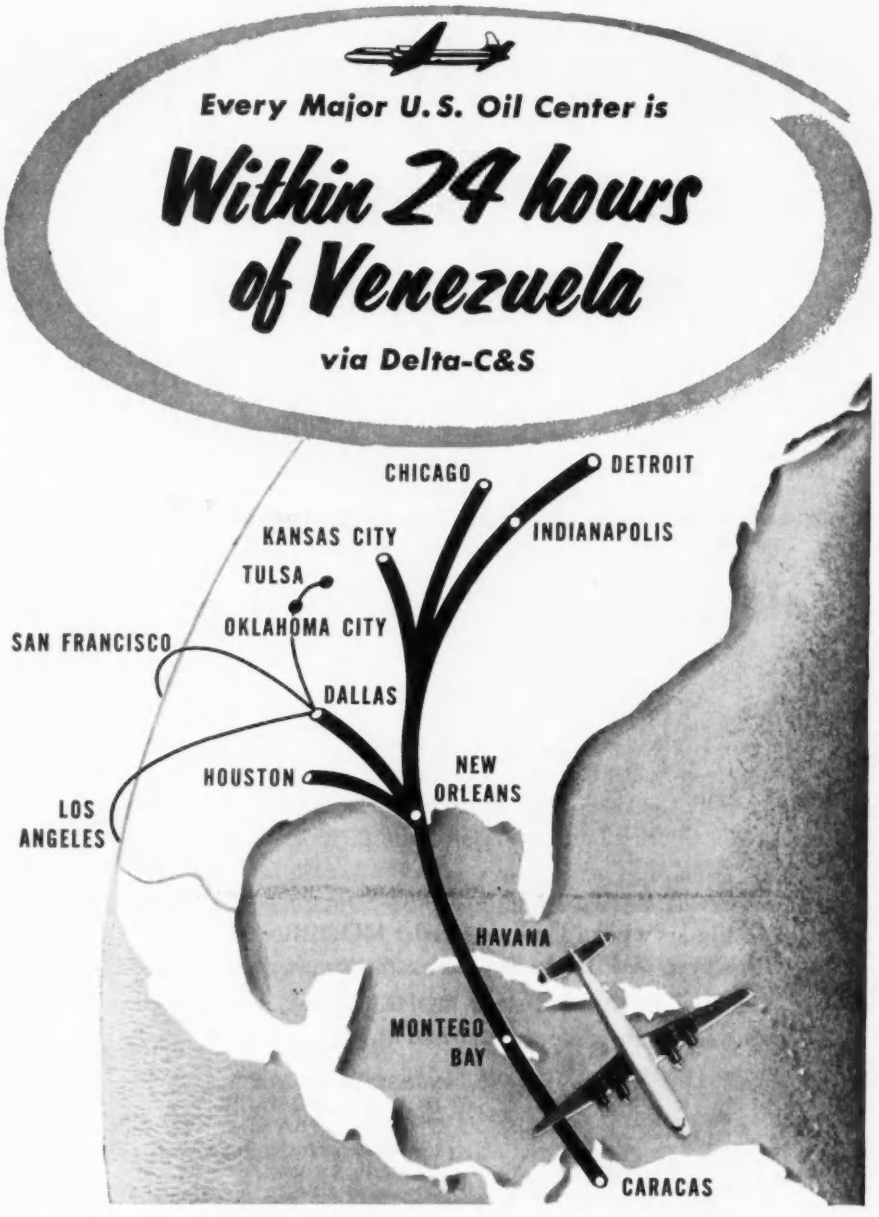
Cowan Named Area Credit Manager For Oil Well Supply in Canada

Promotion of R. L. Cowan, Jr., formerly of the Mid-Continent area credit office at Tulsa to area credit manager for the Canadian area has been announced by U. S. Steels Oil Well Supply Division. He succeeds R. E. Moseley, who has been transferred to a similar post in "Oilwell's" California area at Los Angeles.

Cowan has served in the division's Credit department since 1945 and prior to his Tulsa assignment held credit positions at Columbus, Ohio, and Houston. He was graduated from Austin College at Sherman, Texas, in 1939.

Davis D. Bovaird Addresses Purchasing Agents Association

Davis D. Bovaird, president of the Bovaird Supply Company and president of the Petroleum Equipment Suppliers Association, spoke at the annual convention of the Purchasing Agents Association in Chicago in May. Bovaird addressed the oil buyers group at the convention relative to the relationship between the suppliers of oil field equipment and the purchasing agents of the oil industry.



Through-plane service from the West Coast to New Orleans,* fast connections from Oklahoma, express Constellations straight through from Chicago—all coordinated to land you in booming Caracas first thing in the morning.

There's a 300 mph Luxury Constellation every evening from New Orleans at 7:30 with complimentary refreshments and a special French Quarter dinner. Stops at Havana and Montego Bay, Jamaica.

**Delta-C&S and American Airlines interchange service*

Fastest—Most direct from: HOUSTON DALLAS—NEW ORLEANS SHREVEPORT CHICAGO—ST. LOUIS

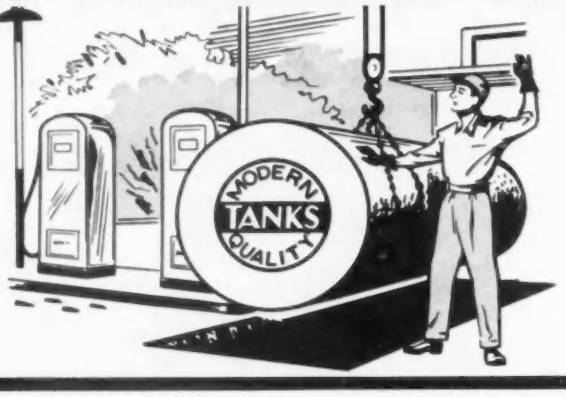
Delta-C&S AIR LINES

. . . the oilman's route to Caracas!

General Offices: Atlanta, Georgia

Ticket offices in: LOS ANGELES, DALLAS, HOUSTON, TULSA, TYLER, KILGORE, SHREVEPORT, NEW ORLEANS, CHICAGO

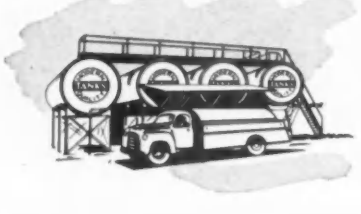
The MODERN Line



a single source for your tank needs

Yes, one line is the direct line to quality storage service . . . MODERN . . . fabricating steel storage tanks to solve every storage problem . . . tanks of heavy-gauge, top-quality steel . . . approved by the Underwriters Laboratories! More and more petroleum distributors and service station operators demand MODERN QUALITY storage tanks . . . good reason to contact your nearest MODERN plant today. Now—join the hundreds of satisfied customers who order and re-order MODERN QUALITY tanks, with a type and size to fit your *exact* storage needs.

The MODERN name . . . the MODERN line . . . guaranteed one year against defective material or workmanship.



MODERN QUALITY HORIZONTAL BULK STORAGE TANKS— tested according to rigid standards for long, efficient service. Stairways, walkways, and supports fabricated to your specifications.

MODERN QUALITY VERTICAL BULK STORAGE TANKS – double butt-welded and tested according to rigid standards for long, efficient service.

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MODERN TANKS QUALITY

modern welding company

INCORPORATED

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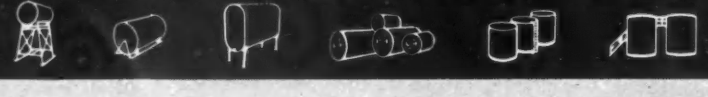


Welex Jet Services, Inc., In New Offices in Tulsa

Welex Jet Services, Inc., is now in new offices at 308 Midstates Building, Tulsa. W. L. (Bill) Carwile, Jr., is Oklahoma service manager. Welex still maintains offices at Oklahoma City under R. C. (Chick) Parker, assistant division manager. As a Seabee during World War II, Carwile was assistant drilling superintendent at the Elk Hills Naval Petroleum Reserve No. 1. He has been with Welex more than five years and has spent 20 years in the oil industry.

W. L. Carwile

Walker Named Sales Manager For Hammond Iron Works

Max G. Walker has been named sales manager for southeastern U. S. for Hammond Iron Works, specialists in design, fabrication, and erection of all types of steel plate structures. Walker spent more than six years as Chicago district sales manager for Murphy Diesel Company of Milwaukee. He was also identified with construction activities in the petroleum and mining industries in South America. He attended Ohio State University and served in the U. S. Navy during World War II. He will have his headquarters at the new Hammond plant in Birmingham, Ala.

Max Walker

Frank Morman Pacific Coast Sales Chief for Marathon Corporation

Frank C. Morman is now in charge of Pacific coast sales for Marathon Corporation, Chemical Division, of Rothschild, Wis. Morman goes to California from the New England area. New Marathon warehouses have been opened in Los Angeles and San Francisco.

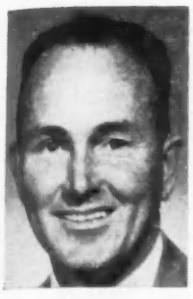
Lane-Wells Newcastle, Wyo., Branch Into New Quarters

The Lane-Wells Newcastle, Wyo., branch has moved into its new quarters on South Stampede Street. The branch is under direction of John H. Tibbs. Sammie Conley heads the radioactivity well logging program; Jim Barton is in charge of perforating.

DeLaval Names Representatives In Panama, Nicaragua, Honduras

Navarro y MacMurray have been named exclusive representative for DeLaval Steam Turbine Company products in the Republic of Panama and the Canal Zone. Maquinaria Universal, Managua, Nicaragua, was named representative in that country. Agencias Hegenbarth will act as representative for DeLaval in Honduras.

(For more data on advertised products, use Readers' Service blue cards, last page this issue.)



Jim C. Orchard

Frank Jones

Sales Force Increased By Cardinal Chemical

Jim C. Orchard and Frank Jones have been added to the Nocor sales force of Cardinal Chemical, Inc., Odessa, Texas.

Orchard was office manager of the Famoso Branch, Roscoe Moss Company, Los Angeles, before joining the Nocor sales staff. Jones, a native Californian, has been at Odessa as sales representative of Pacific Pumps, Inc. for the past ten years.

These appointments were announced concurrently with the introduction of the newest in the Nocor oilwell corrosion inhibitor series, "Nocor '103'," a product of Cardinal's Research department.

Mid-Continent Supply Company Presents More Service Awards

Following up its initial Fort Worth distribution of service awards, Mid-Continent Supply Company has recognized all eligible employes in twelve states, Canada, and South America with gold and diamond service awards.

The Mid-Continent service awards are gold-and-diamond replicas of the world-and-derrick trademark emblem of the organization. One diamond represents each five years of service.

In addition to the awards made by President Ken W. Davis to Fort Worth employes in 1953, service awards have gone to 132 employes outside the Fort Worth headquarters. These represent existing awards through February, 1954.

Twenty-year awards have been presented to J. A. Daugherty, Houston; G. H. Canterbury, Natchez; and W. I. West, Houston.

Receiving 15-year awards are: W. W. Arnold, Midland; G. B. Blair, Shreveport; Ed Brown, Houston; H. H. Brown, Dallas; John C. Carter, Refugio; R. E. Elmore, Houston; C. M. Fleeman, Shreveport; B. S. Harkrider, Great Bend; C. H. Hickman, Odessa; R. L. McAnally, Midland; H. Muery, Houston; A. T. Skaer, Denver; D. S. Smith, Dallas; F. J. Spurlock, Houston; G. A. Wead, San Antonio; and R. S. Weilman, Houston.

Ten-year awards have been made to S. R. Clinkscales, Tulsa; D. V. Crites, Houston; W. M. Day, New Orleans; B. W. Holliday, Houma; G. L. Huestis, Midland; D. L. Johnston, Shreveport; J. P. Jones, Lake Charles; W. H. Loyd, Corpus Christi; C. D. McIver, Abilene; H. E. Martin, New York; L. T. Ratliff, Los Angeles; W. W. Schmid, Houston; W. R. Shuffield, New Iberia; T. N. Shults, New York; A. W. Smith, Houston; and C. G. Tosh, Houston.

Five-year awards went to 91 Mid-Continent employes from Canada to Venezuela.

Any outstanding product is its own best salesman, and this is true of Wichtex Well Servicing Units.

Once a man owns one Wichtex machine, the chances are better than 50 to 1 he'll buy nothing but Wichtex thereafter. This is a matter of actual record, as is the fact that the big majority of all Wichtex sales are repeat sales. A large number of contractors own from four to six Wichtex units.

Wichtex units have proved, throughout their 24 years in the field, their leadership in efficiency, capacity, mobility, and extra years of economical service, at minimum investment.

There is a Wichtex unit for every depth from 1500 to 15,000 feet. Make your next well servicing unit a Wichtex and you'll be "sold" on Wichtex from there on out!

WICHTEX MACHINERY COMPANY INC.

BURKBURNETT ROAD WICHITA FALLS, TEXAS

(For more data on advertised products, use Readers' Service blue cards, last page this issue.)

HOMCO Opens New Sales Store To Serve Casper, Wyo., Area

Houston Oil Field Material Company is now operating a new sales store in Casper, Wyo. HOMCO has maintained a complete service tool location in Casper for some time. The new store offers complete oil field service and supplies for that area.

M. J. (Mutt) Caskey is district sales manager. I. P. (Woody) Woodard is store manager; Walter J. Boulden, field salesman, and Lloyd Moore, driver.

International Harvester Names Burns to Head Truck Fleet Sales

Russell C. Burns has been named supervisor of motor truck fleet sales by International Harvester Company. Burns, a 20-year Harvester sales veteran, has served as general supervisor, used truck merchandising, since May, 1952.

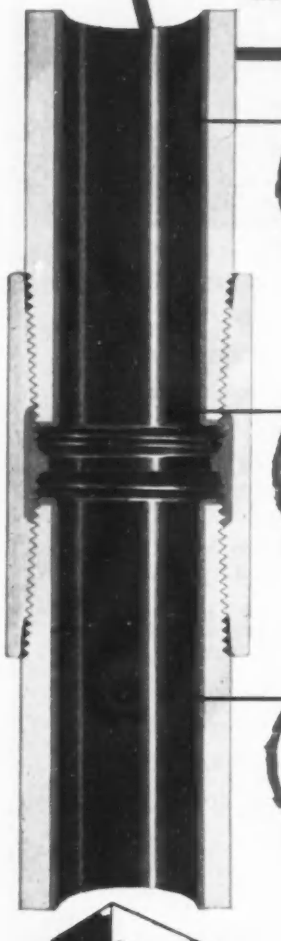
R. H. White has been named manager of the company's new Lubbock (Texas) motor truck district. Other sales personnel changes announced include: M. S. Howard, formerly assistant manager at Sweetwater, Texas, moved to Lubbock in the same capacity, and R. L. Tracy, branch manager, Los Angeles district, promoted to assistant manager, Oakland district.

Republic Steel Corporation Names West Coast Distributor

The Republic Steel Corporation has appointed The Republic Supply Company of California, an independent western concern, as a west coast distributor for its oil country tubular goods, and line pipe.

TUBE-KOTE'S TK-43 LINING

Makes Water-Flood Pay!



Resists corrosion of brine.

Glassy surface ends velocity erosion.

Insulates against electrolytic action.

Water flooding pays off only when injection costs are low—and costs are low if your injection tubing is given long life by TK-43 lining.

Brine and other water used for secondary recovery corrodes tubing with vicious speed—but *not* if the tubing is guarded by TK-43's triple protection: resistance to the bite of brine; a glassy surface that ends velocity-flow erosion; and a plastic insulation against electrolytic action.

Have your new or existing strings lined with TK-43 now by Tube-Kote experts. If paraffin or similar nuisances are cutting your production profits on other wells, get the story on other Tube-Kote tested products such as TK-2 and plastic pipe.

Write for data or see Tube-Kote pages in Composite Catalog.

TUBE-KOTE, INC.

P. O. Box 20037 • Houston 25, Texas

TUBE-KOTE

First Name In Corrosion Resistance

TUBE-KOTE T.M. Reg.

Chiksan Names H. J. Schlarb Special Sales Representative

H. J. Schlarb has been promoted to the newly-created post of special representative in the Sales department of Chiksan Company and Chiksan Export Company. Schlarb will maintain contact with key personnel of customers and prospects and with visiting personnel of foreign operations. He also will handle special assignments and projects. Schlarb has been with Chiksan more than nine years and has had extensive experience with Chiksan products and their application.

H. J. Schlarb

Lynn (Red) Day Named to New Lane-Wells Post in Wyoming

Lynn W. (Red) Day has been named district packer service engineer for the Lane-Wells Newcastle, Wyo., branch. Day has been with Lane-Wells since 1948 and has become acquainted with the problems of the Rocky Mountain fields through service as a perforating operator out of Casper, Wyo., since 1951. Day opened the Lane-Wells branch in Newcastle last September.

L. W. (Red) Day

Renfroe Returns to Lane-Wells After Service in U. S. Air Force

H. M. Renfroe has returned to Lane-Wells as district sales engineer for the Southwest Texas district after two years as a first lieutenant in the U. S. Air Force. He will make Alice, Texas, his headquarters. Before being called into the service in 1952, Renfroe was for two years a Lane-Wells radioactivity well logging operator in southern Louisiana. He received his degree in petroleum geology in 1950 from Mississippi State University.

H. M. Renfroe

Republic Supply Opens Store In the Julesburg Basin Area

The Republic Supply Company has opened a new store at Fort Morgan, Colo., to serve the Julesburg Basin area. The store will serve the areas of northeastern Colorado, southeastern Wyoming and southwestern Nebraska. Morris Gilmore is store manager. Gilmore has been replaced as manager at the Farmington, N. M., store by C. M. Carrington.

J. M. Wigley

R. K. King

K & W Sales and Service Named Representative for Hunt Tool

Hunt Tool Company announces the appointment of K & W Sales and Service as the company's representative in the Rocky Mountain area. K & W Sales and Service is owned and operated by J. M. (Cotton) Wigley and R. K. (Bob) King in Casper, Wyo. Wigley and King, who are former employes of Hunt Tool Company, decided to enter the Rocky Mountain area as manufacturer's agent for a number of products.

R. Carson Allan

Neil B. Biggerstaff

Allan and Biggerstaff Receive Export Division Appointments

R. Carson Allan, division engineer for the Export division of The National Supply Company, has been appointed district manager of the company's expanded operations in western Venezuela, with offices at Maracaibo, Venezuela.

Neil B. Biggerstaff, sales engineer attached to the company's general offices in Pittsburgh, has been transferred to the Export division headquarters, New York City, to succeed Allan.

Caterpillar Distributor Opens Branch Office in Kirkuk, Iraq

John Birch & Company, Ltd., of Bagdad, Iraq, distributor for Caterpillar Tractor Company of Peoria, Ill., has opened a new branch office in Kirkuk, Iraq.

Republic Steel Corp. to Increase Capacity of South Chicago Mill

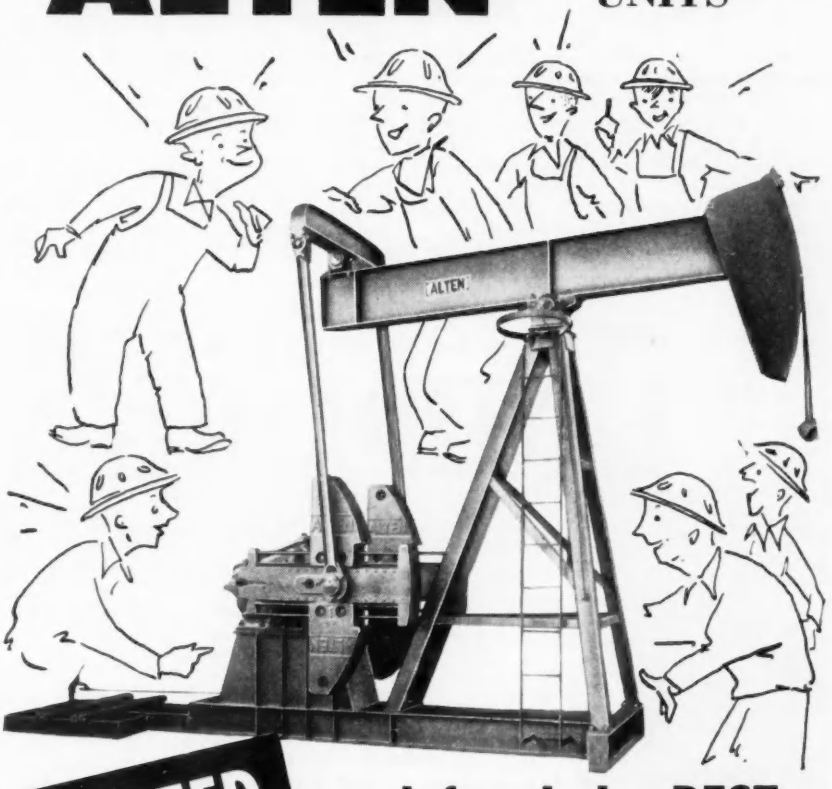
Republic Steel Corporation is increasing the capacity of its South Chicago seamless tube mill nearly 70 percent with the addition of new facilities for rolling small size seamless tubing, according to C. M. White, president.

Work has already begun on the project and completion is scheduled for the spring of 1955. When the new facilities are in operation, capacity of the seamless tube mill will be increased from 186,000 tons a year to 312,000 tons a year.

Weco Moves Meeks to Hobbs

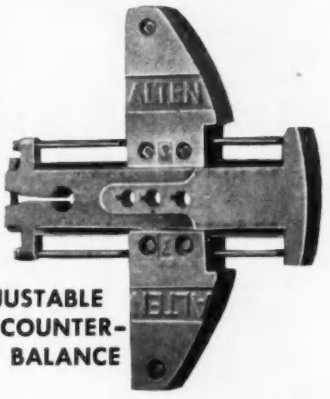
William C. Meeks, Jr., is now representing Well Equipment Manufacturing Corporation out of Hobbs, N. M. Meeks was previously with Weco in Russell, Kan.

Why all the TALK about ALTEN PUMPING UNITS

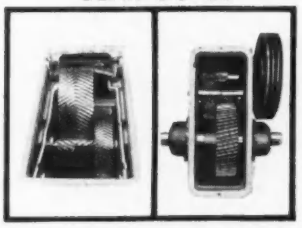


TESTED and found the BEST

Oil fields are buzzing about the performance records being established by the new Alten pumping units. The answer? *More pumping time!* An Alten unit is more than a green-painted, orange-trimmed steel structure. Take a close look and you'll find a carefully engineered machine. All parts have been ingeniously designed for longer life and quick, easy servicing. *Alten now makes every size and makes it better!*



TWO GREAT GEAR BOXES



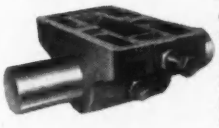
Some pumping situations demand herringbone gears for peak performance, others helical. *Only Alten offers both.* No need to compromise — get the proper gear train every time.

NEW ADJUSTABLE COUNTER-BALANCE

Rugged enough to meet harshest oil field requirements, yet so amazingly simple it can be adjusted in minutes by one man on the ground.

Crank calibration locates weights for desired counterbalance. Weights cannot fall during adjustments — they are safely locked in position at all times.

4 WAY ADJUSTABLE SADDLE — BRONZE BUSHED BEARING



Matchless for long wear and convenience. Simply rotate to a new bearing surface and obtain several times ordinary life. Walking beam may be adjusted laterally and to and from the well for exact centering.

BUY FROM YOUR LOCAL SUPPLY STORE

— ALTEN —
Foundry & Machine Works, Inc.
LANCASTER, OHIO

Personnel Changes Revealed By Oil Well Supply Division

Personnel changes have been revealed by U. S. Steel's Oil Well Supply Division. Elmer E. Stanley has been promoted to field representative at Duncan, Okla. In Pittsburgh, James P. C. Dalrymple has been made assistant treasurer in charge of credits.

William Robert Miller has been made field representative at Odessa, Texas. The new field representative at Borger, Texas, is Joseph R. Nye. Donald E. Kyle is now field representative at Anson, Texas. Hilliard R. Roberts is field representative at Lake Charles, La.

Oilwell recently opened a new branch store at Lindsay, Okla. Doyle E. Richeson, a native Oklahoman and former field representative at Oklahoma City, is manager of the new store.

Phil L. Lynn has been named field representative at Cushing, Okla.

B. J. Travis has been named assistant district engineer, machinery and equipment sales and service, in Oilwell's Central Midwest area. He has headquarters in Odessa, Texas.

William T. Carter, Jr., has been named district representative at Ardmore, Okla., and Joe E. McCrary and Charles E. Damron, Jr., were named field representatives at Oklahoma City and Lindsay, Okla., respectively.

John Herbert Ahrens is now Oilwell field representative at Casper, Wyo. Norman E. Cordell now holds a similar post at Clay City, Ill.

Ben A. Brooks has been named feld representative at Harvey, La., for U. S. Steel's Oil Well Supply Division.

Tom K. Cone is filling the newly-created post of training and visual aid specialist for U. S. Steel's Oil Well Supply Division in the Dallas home office.

Formerly a commercial photographer in Dallas, Cone joined Oilwell in 1949 at the Dallas office and has specialized in plant, equipment and other industrial photography.

R. W. Ard

J. R. Acton

Ard Heads New Totco Division; Acton Added to Oklahoma Staff

The Technical Oil Tool Corporation service organization in Oklahoma and Kansas has been designated as a division and placed under the direction of R. W. (Bo) Ard. Ard, with Totco since 1949, will headquarter in Oklahoma City.

James R. Acton has been added to the Totco staff. Acton was formerly employed by supply store in Oklahoma City.

Alten Names W. B. Hudson North Texas Area Representative

W. B. (Bill) Hudson has been named district representative for Alten Foundry & Machine Works in the North Texas area.

Hudson started his business career with J. C. Jennings, joined Jarecki as a salesman and subsequently was advanced to district manager. He came to Alten from the Ideco Supply Store division of Dresser Industries where he has been serving in an executive sales capacity. Although Hudson will reside in Jacksboro, Texas, he will make his business headquarters at the Alten warehouse in Wichita Falls.

BS&B Appoints Ralph W. Nichols To District Sales Manager Post

Ralph W. Nichols has been appointed sales manager, Fort Worth district, for Oilfield Sales & Service division, Black, Sivalls & Bryson, Inc.

The Fort Worth and Abilene sales territories have recently been combined, with consolidated district offices established at Fort Worth.

Nichols, formerly BS&B's Oklahoma City District sales manager, served successively as estimator, draftsman, engineer, project engineer, contact man and manager of the Fort Worth sales office. From 1945 until late 1950 he was sales manager for the Richmond Engineering Company. He rejoined BS&B in a sales management capacity in December, 1950. In October, 1952, he was named district sales manager, Oklahoma City sales district.

Ralph W. Nichols

LINE PIPE COUPLINGS A.P.I.
1/8" to 12"—Seamless and Special Processed—Black or Galvanized
PLAIN TUBING COUPLINGS A.P.I.
1" to 3"—Seamless
EXTERNAL UPSET TUBING COUPLINGS A.P.I.
¾" to 3½"—Seamless
CASING COUPLINGS A.P.I.
4½" to 13⅜"—Long or Short
HYDRAULIC COUPLINGS
⅛" to 4"—Seamless
REAMED AND DRIFTED A.I.S.I.
¾" to 12"—Seamless or Special Processed
DRIVE PIPE COUPLINGS
⅜" to 12"—Seamless or Special Processed

Sales Offices in Leading Cities

Albany, N. Y.—Albert L. Becker, 434 Clinton Ave.
Baltimore, Md.—Ted Barto, 2301 N. Charles St.
Chicago, Ill.—Harry A. Jay, Suite 1090, Old Colony Bldg.
Denver, Colo.—Earl H. Jones & Co., 1863 Wazee St.
Detroit, Mich.—Thomas L. Osberger, 10226 Woodward Ave.
Erie, Pa.—R. J. Maggi, Box 711
Falmouth, Mass.—Walter S. Bennett, 53 Minot St.
Houston, Tex.—Henry H. Paris Distributor, Inc., Box 932
Los Angeles, Cal.—James A. Riordan Co., 1400 Santa Fe Ave.
Minneapolis, Minn.—Lin J. Krause, 5605 Lyndale Ave. S.
Narberth, Pa.—J. W. Worthington, 105 Forrest Ave.
New York, N. Y.—Henry Stein, 50 Cliff St.
Portland, Ore.—Earl H. Jones & Co., 1233 NW 12th Ave.
Richmond, Va.—P. C. Abbott & Co., 15 E. Franklin St.
St. Louis, Mo.—Mike A. Boyle, 5628 Gravois Ave.
San Francisco, Cal.—Earl H. Jones & Co., 1150 Folsom St.
Seattle, Wash.—Earl H. Jones & Co., 819 Thomas St.
Summit, N. J.—Ira L. Rothenberg & Assocs., P. O. Box 475

WHEELING MACHINE PRODUCTS COMPANY
WHEELING, WEST VIRGINIA
Factories at WHEELING, W. VA. and WOODLAKE, CALIFORNIA

(For more data on advertised products, use Readers' Service blue cards, last page this issue.)

WORLD OIL'S Trading Post
CLASSIFIED ADVERTISING

RATES: Regular Classified (undisplayed) set in this size type: 12 cents per word. Minimum charge, $3. Blind box address in our care counts six words. Replies forwarded without charge. **Situation wanted** ads, 6 cents per word. **Display ads,** set in suitably larger type with ruled border, $12 per column inch; situation wanted display ads, $6 per column inch. Ten percent discount for two or more insertions of same copy in consecutive issues. **All classified ads payable in advance. COPY DEADLINE:** 5th of month preceding date of issue. Send copy and checks to: **Trading Post Section, World Oil, P. O. Box 2608, Houston, Texas.**

FOR SALE

■ FOR SALE: New Emsco G-42 Drawworks complete with Caterpillar diesel engines, Gardner pumps; with or without 129' Emsco mast or 96' Ideco or drill pipe and drill collars. Priced at less than 50c on the dollar. Phone, wire or write Dunlap & Graham, Inc., 2450 Cerritos Avenue, Long Beach, California.

■ Registered 5 year Federal Lands, Arizona, leases $3.00 per acre plus liberal bonus in well drilled to 3212 feet. Production expected in Pennsylvanian Limestone between 3500 and 4000 feet. For details write Mineral Development Project A, 3411 N. 14th Place, Phoenix, Arizona.

■ FORT WORTH SPUDDER, "Jumbo C" and drilling tools. Iron mast, mounted on rubber, trailer hitch. Have drilled to 2165 feet. Price for all $6000. W. H. Mossor, Harrisville, West Virginia.

■ FOR SALE: Cooper model "D" 2-drum oil field hoist, powered by Allis-Chalmers 565 cu. in. slow-speed engine. Line speeds from 21 to 1000 ft. per minute. Bare line ratings up to 52,000 lbs. Contact Layne Ohio Co., 1100 W. Town St., Columbus 22, Ohio. Telephone Fletcher 3803.

FRANKS MODEL 5000 Spudder—Serial No. 866
Sales Price—$7,500

Equipped with one Cummins HB1-600 Engine in good condition. Brake rims in fair condition; Brake blocks—Good. General appearance—Good. Chains—Good. Basic Machine equipped with Spudding attachment, Skid and 65' Double Leg Pipe Mast with 8⅝" and 7" Pipe Legs; 4-Sheave Crown of Wilson Manufacture. Price includes Mast Guy Lines.

Location of Unit—Western Kansas
Contact Cardwell—Wichita

Use the Readers' Service Cards

For more information on New Equipment described in this issue, for copies of the literature reviewed, and for data on any advertised products, use the Readers' Service Cards on the last page, just inside the back cover. Circle on the card the editorial or advertising code numbers of the items desired. Sign and mail the card. Your requests will be forwarded to the manufacturer and the information will be mailed directly to you.

FOR SALE

WILSON GIANT—Serial No. 6383
Sales Price—$6,000

Equipped with Two Waukesha 145 GK Engines in good condition. General appearance—Fair. Rig used for Work-Over. Price includes Kelco Spinning and Foster Breakout Catheads; Stromberg-McCreary Air Starters on Engines. Brakes circulating water-cooled; Manual Friction Clutches in Transmission; Others—Jaw Clutches. Rig has Slush Pump Drive and Rotary Drive.

Location of Unit—Lake Charles, Louisiana
Contact Cardwell—Houston

FRANKS ETS—5000—Single Drum Hoist Less Engine
Sales Price—$1,500

General Appearance—Good. Unit complete with Franks Power Take-Off; Mounted on Steel and Wood Truck Bed.

Location of Unit—Winfield, Kansas
Contact Cardwell—Wichita

WILSON ATLAS
Sales Price—$21,000.00

Equipped with two L1-600 Cummins Diesel Engines in good condition: includes pump drive, 12 PD groove sheave and V-belts. One American cathead and one plain spool cathead. Compound enclosed oil-bath. Includes one 1000 gal. fuel tank. Contact Cardwell—Houston.

HELP WANTED

Petroleum Engineers

Major oil company in South America has varied positions for single graduate engineers. Must have minimum one year each production and engineering experience. Reply giving full details—age, experience, college, military status, etc. Box 29-W, c/o World Oil, Houston, Texas.

Mechanical Engineer

For Sales and Service
BEAIRD – INGERSOLL-RAND
PACKAGED GAS COMPRESSOR PLANTS
Salary and Commission Plus Many Employee Benefits
The J. B. BEAIRD COMPANY, INC.
P. O. Box 1115, Shreveport, La.

■ WANTED: Spanish speaking diamond driller capable of operating Joy machine and handling drilling crew, records, samples and supplies for six months' job in Cuban mountains. State experience and salary. Box 27-W, c/o World Oil, Houston, Texas.

BUSINESS OPPORTUNITIES

■ CUBA is bound for an oil boom, as Jatibonico findings foretell. Holder of valuable oil field concessions will hear offers from responsible parties having enough resources, know-how to put these fields into production. Write for information. P. O. Box 2354, Havana, Cuba.

SITUATIONS WANTED

Drilling contractor operating in West Texas and New Mexico desires to contact small or medium-sized independent oil company who needs an operating manager. Personal interview desired. Twenty years experience in all phases of the oil industry. Address replies to Box 94-W, WORLD OIL, Houston 1, Texas.

Young man, Holland-American background, with widespread contacts, and whose experience as landman, oil company executive and independent particularly fits him to new or expanding operations, seeks association with enterprising individual or company. Can offer unusual talents for unusual job. Box 26-W, c/o World Oil, Houston, Texas.

■ EMPLOYED GEOLOGIST—32, married, four and one half years experience with major oil company. Desires position with medium to small company or independent in Rocky Mountain region. Experience includes seismic interpretation, surface, photo and subsurface geology and well sitting. Good references. Box 28-W, c/o World Oil, Houston, Texas.

DECALS

■ TRUCK LETTERING AND TRADEMARK decals made for your trucks. Easy to apply, uniform, distinctive, economical for small or large needs. Write for Catalog. Mathews Company, 827 S. Harvey, Oak Park, Ill.

GEOPHYSICAL SERVICE

■ OIL LOCATING SERVICE! Determine approximate depth and thickness of oil zones. Drilling locations pin-pointed. NO OTHER GEOPHYSICAL WORK NEEDED! Documentary proof of success. WORTH INVESTIGATING! YOUNG AND CRITCHLOW, 1975 NW Everett, Portland, Oregon.

Now Ready—

NEW OIL INDUSTRY

BOOK CATALOG

Gulf Publishing Company's new free book catalog is now ready. It lists the numerous books on all phases of the oil industry for sale through Gulf Publishing Company.

This new catalog can help you build up a well-rounded library of technical and practical job-help data.

SEND FOR YOUR FREE COPY
Mail Coupon Below

GULF PUBLISHING COMPANY: Send without charge your book catalog to:

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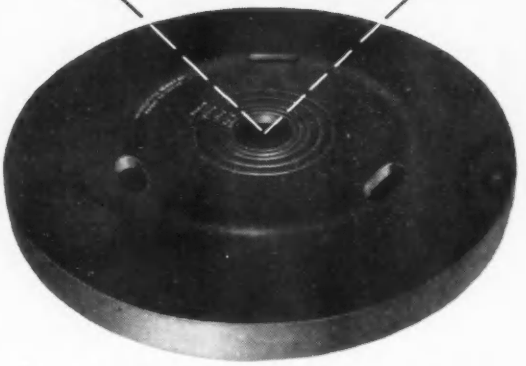
Mail this coupon to

GULF PUBLISHING COMPANY
BOOK DEPT.
P. O. Box 2608, Houston 1, Texas

The new U.S. double-lip pipe wiper

S-T-R-E-T-C-H-E-S OVER 500%



The U. S. Double-Lip Pipe Wiper is easily installed without the use of cones or special tools.

Cross-section (above) shows the two wiping edges, which *eliminate* the need of installing *two* wipers. The strong reinforcing ring imbedded in the rubber prevents distortion and assures that the wiper will retain its normal shape. The wiper is also ideal for geophysical rigs, as well as for wiping tubing. The U. S. Wiper leaves the pipe surface thoroughly clean and dry after pipe is pulled through.

Here is the pipe wiper that can stretch to over 5 times its normal dimensions. This guarantees the wiper will grip the pipe closely, provide a firm wiping pressure under all conditions, and give enough stretch to avoid splitting, even if the bit is accidentally pulled through. The lower lip does the primary wiping, gets the major wear. After the lower lip has delivered full service life as the primary wiping surface, you simply reverse the wiper. Double the efficiency—double the life.

This pipe wiper owes its stretchability, toughness and abrasion-resistance to the fact that United States Rubber Company grows its own rubber and makes its own rubber compounds. This means complete control of the manufacturing process from start to finish—and results in an unmatched quality product.

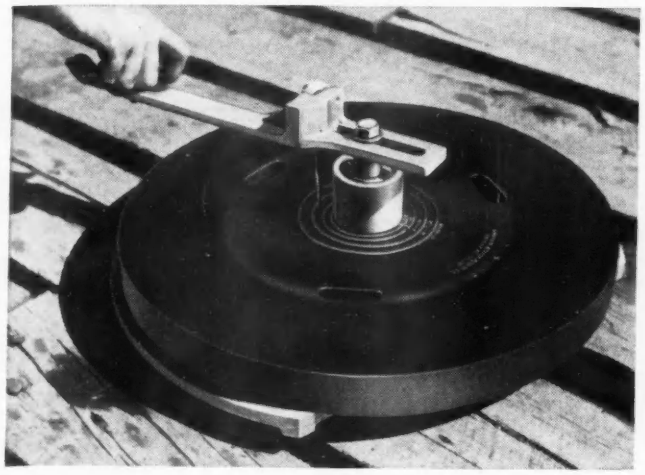
US RUBBER

"U. S." Research perfects it . . . "U. S." Production builds it . . . U. S. Industry depends on it.

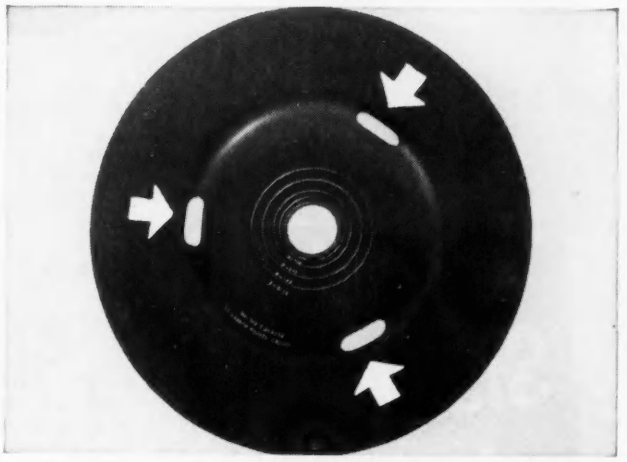
UNITED STATES RUBBER COMPANY

MECHANICAL GOODS DIVISION • ROCKEFELLER CENTER, NEW YORK 20, N. Y.

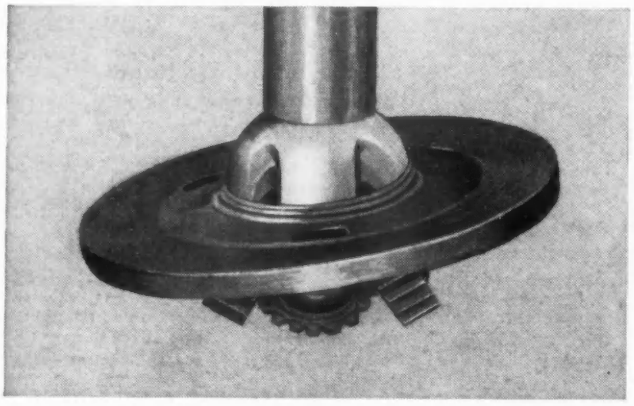
–for double service, double life!



EASILY CUT TO PIPE SIZE . . . U. S. Pipe Wipers are designed with concentric molded rings around the wiping hole. A simple cutter, shown above, cuts the wiper to the desired pipe size.



COMBINATION WINDOW AND DRAIN PORT allows the operator to maintain a check on the vital mud level, and provides a drainage area for any excess mud that may accumulate between the double lips.



LESS DANGER IF BIT ACCIDENTALLY PULLS THROUGH . . . The amazing stretchability of the special rubber compound reduces the possibility of the wiper being damaged if the bit is accidentally pulled through. No cuts or slits are required to prevent tearing.

FOR ALL PIPE SIZES

Drill Pipe Size, in.	Size O.D., in.
2⅜ to 2⅞	9
2⅜ to 5 9-16	14
2⅜ to 6⅝	17

U. S. SINGLE-LIP WIPER

An economical wiper that retains its shape. Its soft, flexible rubber assures good service and clean wiping. Made for all sizes of pipe in 9″, 14″ and 17″ O.D. dimensions.

U. S. RUBBER PIPE PROTECTORS . . .

These have outstanding elasticity, even though they are compounded of Neoprene to combat oil. They are easy to apply, yet stand up under the toughest jobs, resisting cutting, abrasion, swelling and the ruinous effects of oil base mud and acid—as well as oil. There is *no* slippage. You are dollars ahead when you *always* have U. S. Pipe Protectors put on your drill pipe.

Available in all oil fields, at supply stores and obtainable at any of our selected distributors

Stands up after the Pump is down

Used as check valves, Kennametal Balls and Seats resist shock, sand-cutting, corrosion, and pitting up to 5 times longer than "special" alloys. They provide unexcelled service in sour crudes, hydrogen sulfide gases, and flour sand cut fluids. Costly string pulls are less frequent, production volume is greater.

Kennametal Balls and Seats (either flat or rib type) are sold by your regular supplier, in A.P.I. specifications. Kennametal Inc., Latrobe, Pa.

KENNAMETAL
LIGHT-WEIGHT
BALL

Made of corrosion-resistant titanium carbide, ⅓ lighter than steel. Minimizes down-well check valve trouble caused by ball flutter, cage wear, and fluid pounding.

KENNAMETAL®
PUTS AN END TO DOWN-THE-HOLE CHECK VALVE TROUBLE

A Young Man's Viewpoint

On a children's query show a boy about seven was before the microphone.

"It's man's best friend," began the M.C., "and the word begins with 'D'."

"Dame," the youngster answered.

A Few Pounds Longer

Joan: "I simply can't stand my husband. He has such a nasty disposition he's made me so jittery that I'm losing weight."

Aunt: "Why don't you leave him and go back to mother?"

Joan: "Oh, I will. I'm just waiting till he gets me down to 120 pounds!"

Silly Question!

"What the deuce are you doing down there in the cellar?" asked the puzzled rooster.

"Well, if it's any of your business," replied the hen, "I'm laying in a supply of coal."

Prompting

Housewife: "Would you like some cake?"

Tramp: "Yes."

Housewife: "Yes, what?"

Tramp: "Yes, dear."

Awkward Age

Visitor: "And how old are you, Bobbie?"

Bobbie: "I'm just at the awkward age."

Visitor: "Really? And what do you call the awkward age?"

Bobbie (bitterly): "I'm too old to cry and too young to swear."

Pete still scares th' daylight outa th' new geologists with that stuffed cat rigged up like a piece of core.

Fruitless Habit

First Old Maid: "Do you always look under the bed?"

Second: "Always."

"Ever find anything there?"

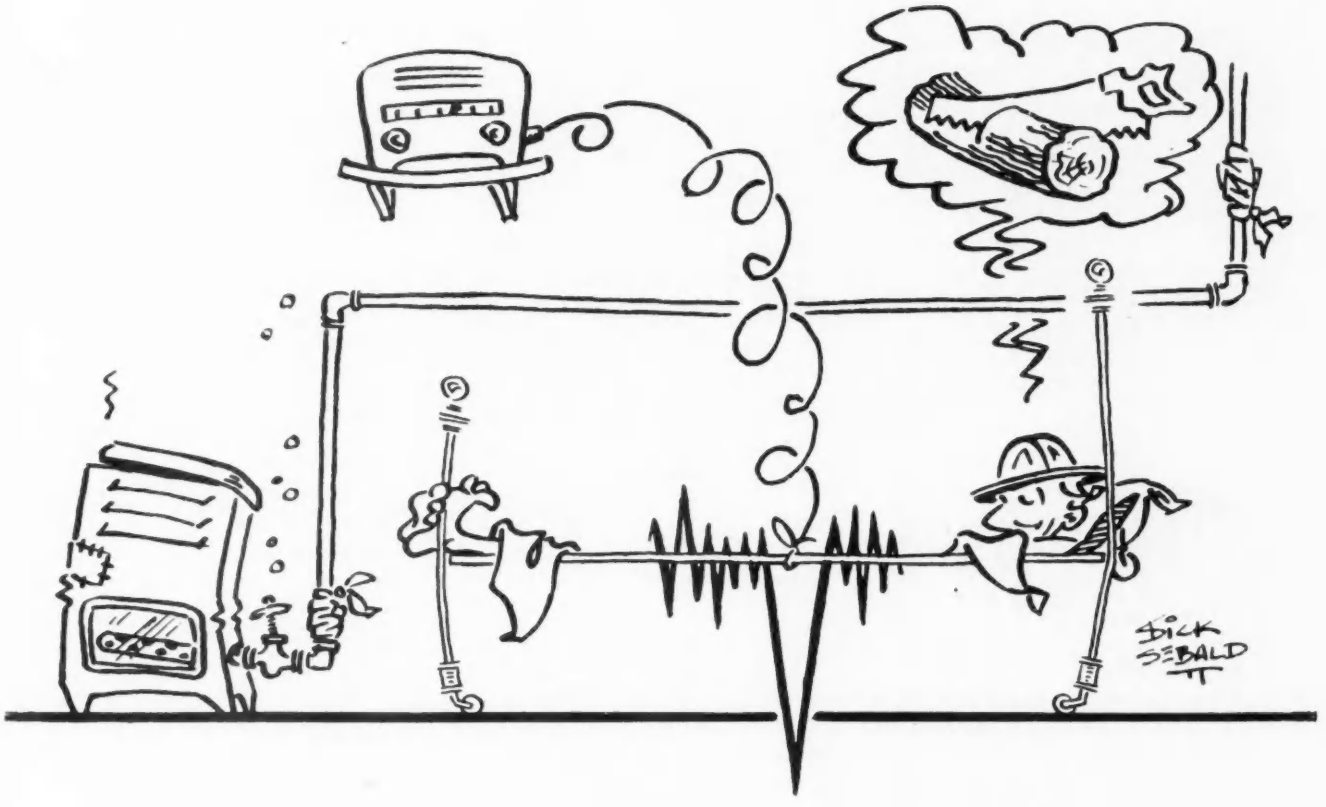
"Only in old fashioned hotels."

Just a Dream

The new stenographer looked like a million dollars. Class was written all over her. The office force in accord acclaimed "some dame." Then she opened her velvet lips and said to the office boy: "Say, bozo, ain't there no carbon paper around this dump?"

Gotkool
water cans and coolers
GOTKOOL WATER CAN
Made in 1½, 2, 3, 5, 10, 15 and 20 gallon sizes. Push-Button Faucet at slight additional cost.
KEEP PURE DRINKING WATER ALWAYS HANDY
GOTKOOL WATER COOLER
Made in 2, 3, 5, 8, 10, 15 and 20 gallon sizes with Push-Button Faucet.
GOTT Water Coolers are the convenient way to keep drinking water handy to the worker, protect it from impurities. Their exclusive construction keeps water cool for long periods. Snug-fitting, large, removable top, handy non-leaking push-button faucet. GOTT Water Cans for handy field use. Your supply store has them, get one today!
STANDARD OF THE OIL FIELDS
Insist on the Genuine
Gott
GOTKOOL WATER COOLER
PURE WATER
H. P. GOTT MFG. CO.
WINFIELD, KANSAS

Are you missing . . .



. . . possible productive thin beds?

You may never know unless you log ALL zones . . . thick or thin with the new

McCULLOUGH
Radiation Well Logger

It's 100 times more sensitive per unit of volume than other type counters. For a true picture of your well – Gamma Ray and Neutron Logs – call McCullough

FOR BEST RESULTS LOG AND PERFORATE BY McCULLOUGH

The only safe sure way to eliminate paraffin

ROTATING SCRAPERS
HUBER
ELIMINATE PARAFFIN

SCRAPERS

If paraffin accumulation in pumping wells is your problem, it will pay you to get HUBER SCRAPERS—the only safe, sure method of *automatic* mechanical paraffin elimination.

Hundreds of operators are satisfied users of Huber oil field production equipment which also includes:

HUBER Universal Rod Rotators: they prolong coupling and barrel life by distributing wear equally.

HUBER No-Bolt Polished Rod Clamps: the *new* polished rod clamp with no bolts to tighten.

Get Huber equipment at your supply store or contact one of our shops:

General Oil Tool Company, Duncan, Oklahoma
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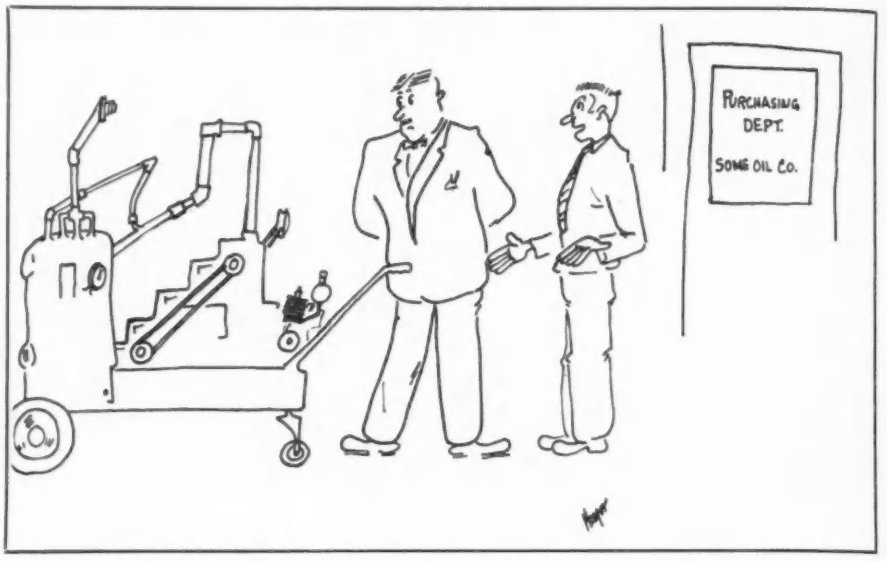
Easter's Welding Service, Russell, Kansas
Northwest Industries, Ltd., Edmonton, Alberta
J. M. Huber Corporation, Sundown and Odessa, Texas

SEE OUR CATALOG IN THE COMPOSITE CATALOG

—or write direct to:
J. M. HUBER CORPORATION
Box 831 Borger, Texas



I really don't know what it is, but they had such a good price on it that I bought it.

Just Trying to Be Polite

The other day I met the sweetest young lady. She was in the lobby of a hotel and as usual, we started a conversation about the weather.

The girl said, "Do you know, I find it so much colder up here than back home. There I wore light garments all winter, but since coming here I have had to put on heavier clothing. I'm from Georgia, you know."

"Is that so?" I said politely, to show my interest. "I'm from Missouri."

She gave me a look I'll never forget.

Promises

When the husband came home drunk his wife assailed him with, "If you don't stop this drinking and carousing, I'm going to kill myself!" Retorted the hapless husband, "Promises! That's all I get . . . just promises!"

Just One More Thing

Salesman (in car to sweet young thing on the curb): "Pardon me, Miss, but . . . er . . ."

Babe: "No, you've never met me in New York, Atlantic City or Hollywood, I wasn't at the party last month or at Charlie's Bar. I know I'm good looking and I'm not bashful. I'm not waiting for a bus or going your way. I'm not lonely, and I just had dinner, and I've got lots of boy friends, and my real sweetie pie weighs 220 and plays left tackle. Now were you going to say something?"

Salesman: "Yes, dammit. You're losing your skirt."

Long Time!

Boss: And how long have you been working here?

Clerk: Ever since I heard you coming down the hall.

"The Neutron Curve indicates FLUID!"

CLAIMS AND ENGINEERING SERVICE

Responsible for
REDUCTION in.... INSURANCE COSTS

What
POLICYHOLDERS *Say*

This is one of many testimonial letters received from policyholders of the Texas Employers Insurance Association.

Ask the Texas Employers representative nearest you to show you more of these letters, as proof of what Texas' largest writer of Workmen's Compensation Insurance can do for you.

40TH ANNIVERSARY 1914-1954

WE QUOTE FROM A POLICYHOLDER'S LETTER

"Please accept our thanks for the dividend check in the amount of $2,962.24 which you delivered to me today. This cash dividend, together with guaranteed cost discount deducted previously makes a total savings of 43.6 percent on our workmen's compensation insurance.

"It will be appreciated if you will express our appreciation to your claims and engineering departments for the fine service they have rendered us. The service of your safety engineer together with the promptness in which our claims have been handled are in a big way responsible for this nice reduction in our insurance cost."

Largest Writer of WORKMEN'S COMPENSATION INSURANCE *in Texas*

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Service Offices: ABILENE • AMARILLO • AUSTIN • BEAUMONT • CORPUS CHRISTI • DALLAS • EL PASO FORT WORTH • FREEPORT • GALVESTON • HARLINGEN • HOUSTON • LUBBOCK • MIDLAND ODESSA • PORT ARTHUR • SAN ANGELO • SAN ANTONIO • SHERMAN • TYLER • WACO • WICHITA FALLS

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THE GREATEST IMPROVEMENT ...FOR CENTERING CASING WHILE CEMENTING SINCE 1925

B and W
LATCH-ON CENTRALIZERS
with the NEW
KON-KAVE BOW

B and W KON-KAVE BOW combines a curved cross-section, highest quality spring steel, drop forging, and the proper heat treatment to relieve all stresses created in forming and welding B and W KON-KAVE BOWS.

FIRST IN THE FIELD!

- Strongest—greatest resistance to side thrust.
- Most resistance to deformation . . .
- Easiest to install and run.

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Well Completion Specialists

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WEST COAST
Box 3751
Los Angeles 54, Calif.
Phone ME-4-1106

Got to Be!

Policeman (to intoxicated man trying to fit key into a lamp post): I'm afraid there's nobody home there tonight."

Drunk: "Mus' be. Theresh a light upstairsh."

Never Mind

A minister advertised for a handy man and the next morning a neat young man rang the bell.

Minister: "Can you start the fire and have breakfast ready by 7 a.m.?"

Young Man: "I think I can."

Minister: "Can you polish all the silver, wash the dishes, and keep the house tidy?"

Young Man: "I guess so."

Minister: "Can you mow the lawn, fix the plumbing and see that everything is shipshape?"

Young Man: "Look, Reverend. I came here to see about getting married, but if it's going to be anything like that, you can count me out right now."

Sad Words

The saddest words
Of tongue or pen:
"We just sold Junior's
Buggy when—"

Sad Fate

Michael had taken a strong dislike to kindergarten. All persuasion failed and finally his mother told him firmly that he would have to go. "All right," retorted Michael. "If you want me to grow up into a danged bead stringer, I'll go."

". . . and my girl friend thinks the oil business is glamorous."

Small World

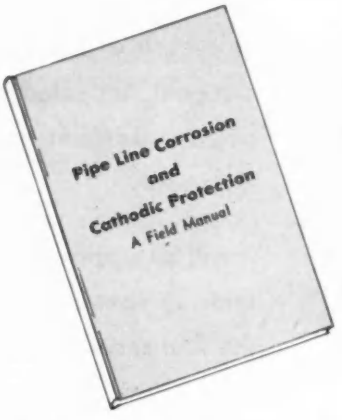
A group of American tourists were being guided through an ancient castle in Europe. "This place is 600 years old. Not a stone in it has been touched, nothing altered, nothing replaced in all those years," the guide said.

"Well," said one woman drily, they must have the same landlord I have."

Vintage Makes a Difference

"Which would you rather give up—wine or women?"

"It depends on the vintage of each."



get this new handbook on . . .

Pipe Line Corrosion and Cathodic Protection

A FIELD MANUAL

This Handbook, written by Marshall E. Parker, consultant, is designed as a practical field manual. It is a 108-page pocket-size volume printed first as a popular series in WORLD OIL. The Handbook is illustrated with many charts and drawings and is completely indexed by subjects.

It presents comprehensive data on Soil Resistivity Surveys, Potential Surveys, Line Currents, Current Requirements, Rectifier Systems, Ground Bed Design, Magnesium Anodes, Stray Current Electrolysis, Interference in Protective Systems, Operations and Maintenance, and Coating Protection and Testing.

An appendix has been added of technical data on Underground Corrosion, Basic Principles of Cathodic Protection, Properties of Metals and Attenuation Equations. Order copies of this practical Field Manual now for each of your field men. Price $3.

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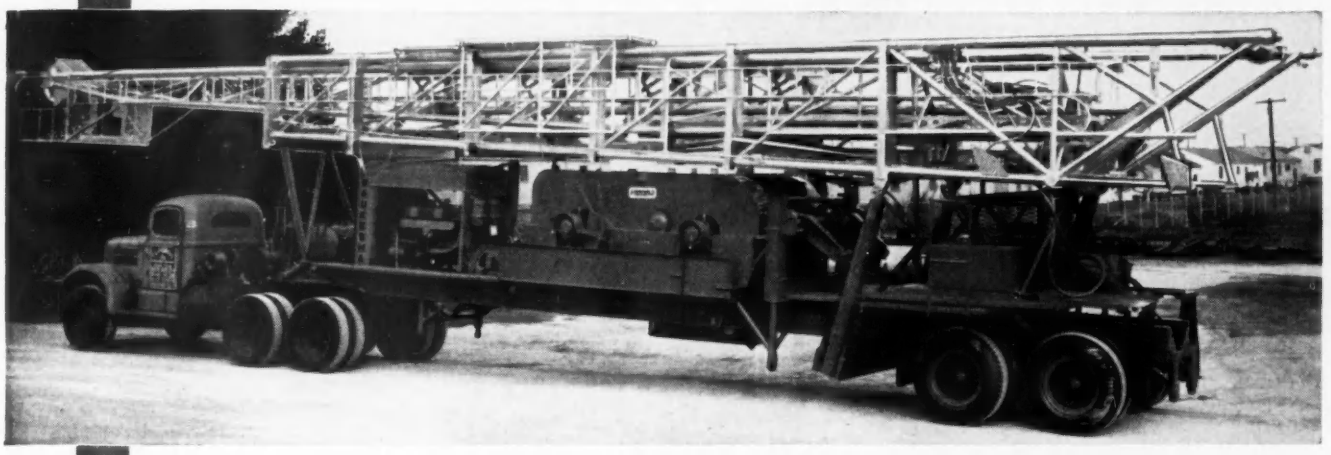
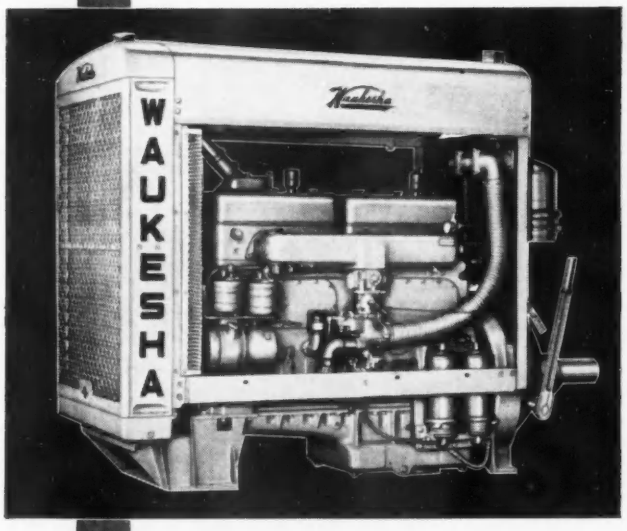
it takes WAUKESHA power

for this FRANKS 6,000-foot Drilling and Spudder Rig



Here is another stand-out example of Waukesha Engine power and performance in the oil fields. Pictured above is a Franks "Comet" Model 137-DTD trailer-mounted combination slim hole rotary drilling and spudder rig, owned by the B.R.&L. Drilling Co. of Farmington, New Mexico. This 96-foot, 200,000 lb. capacity telescoping derrick, especially designed for fast mobility and portability, is powered with a Waukesha WAKU combination gas unit, shown below.

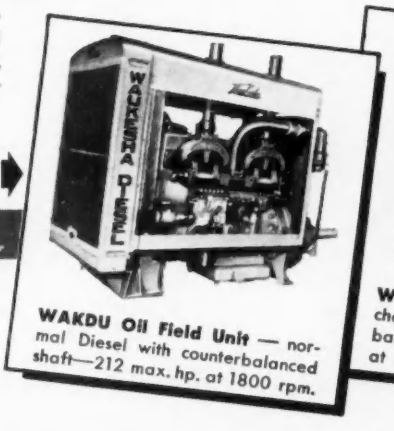


● This modern power plant is a rugged 1197 cu. in. six-cylinder, overhead valve engine, equipped with combination gas-gasoline carburetor, regulator, top cylinder oilers, water-cooled exhaust, heated intake manifold, and other accessories for oil field service. Its design and construction give a steady flow of power under full rated continuous duty load, with a big reserve for overload or emergencies. For detailed information and specifications on the popular 6-WAKU Oil Field Special, send for Bulletin 1556.

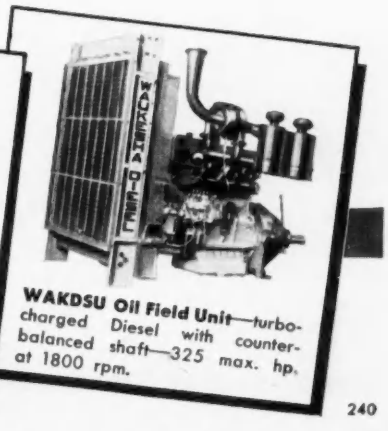
Remember—Waukesha Engines and Power Units, for every oil field service, operate on Diesel fuels, natural gas, butane or gasoline, and range from 10 hp. to 600 hp. Ask for Bulletin 1079.

WAKU Oil Field Unit—combination gas, gasoline—225 max. hp. at 1500 rpm, with standard crankshaft. (Also available as Model WAKBU, a straight gas unit, with counterbalanced shaft—275 max. hp. at 1800 rpm.)

Waukesha WAK Series includes these Diesels:



WAKDU Oil Field Unit — normal Diesel with counterbalanced shaft—212 max. hp. at 1800 rpm.



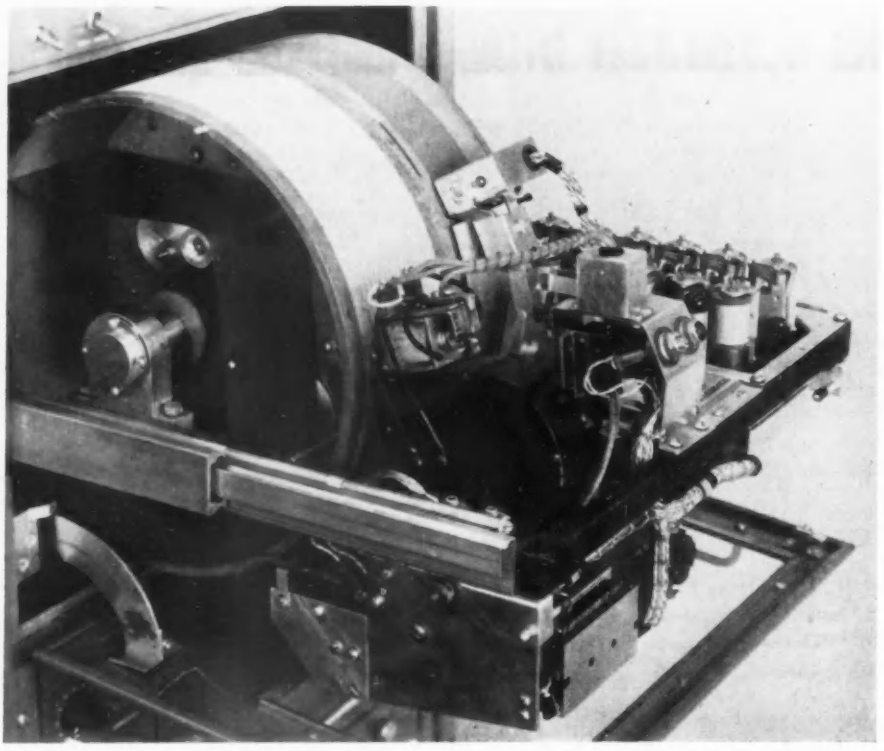
WAKDSU Oil Field Unit—turbo-charged Diesel with counter-balanced shaft—325 max. hp. at 1800 rpm.

WAUKESHA MOTOR COMPANY
WAUKESHA, WISCONSIN
NEW YORK TULSA LOS ANGELES

240

What's New in Equipment

Drilling • Production • Exploration



You can make accurate and permanent records with this

Geophysical Magnetic Recorder

The Brush Electronics Company has released a set of new equipment for geophysical exploration work. Two instruments, a truck mounted multichannel magnetic recorder with automatic visual monitoring, Model BK-315, and a field station unit, Model BK-202, for repeated playback and detailed analysis of the previously recorded material provide the oil industry with a new powerful tool.

The heart of the magnetic recording system is a drum driven at constant speed which carries on its periphery, side by side, a strip of magnetic tape and a strip of electrosensitive paper. The seismic signals are first recorded on the magnetic tape and are immediately thereafter transferred to the electrosensitive paper by means of a direct-writing penmotor, leaving a multichannel visual trace for monitoring purposes. Wide frequency response, low distortion, and minimum phase errors are assured by the use of a frequency modulated carrier.

In accordance with the well established requirements for geophysical exploration recorders, a recording period of five seconds has been chosen. Twenty-five separate information channels and one timing signal can be recorded simultaneously.

Operation of the truck unit is highly automatic. After the operator presses two push buttons simultaneously, the recording cycle is initiated, the explosive charge is fired at the proper moment, the seismic data are recorded on the magnetic tape, and a visual tracing appears within two minutes on the chart paper.

The field station magnetic reproducer unit is also equipped with a drum for easy mounting of the previously recorded magnetic tape. During each revolution of the drum the originally recorded electrical signals are exactly reproduced. These signals can then be passed through filters or exposed to other analytical techniques which assist in their interpretation. A high degree of flexibility in the study of seismic information is thus obtained without the need of firing additional explosive charges.

This new equipment features sturdy construction for field operation under difficult climatic conditions, a frequency response from 10 to 500 cycles per second, immediate visual monitoring of the trace, timing accuracy within a half millisecond, and complete automatic operation. Magnetic tape and chart record paper can be easily replaced, and there is no need for photographic equipment in the field truck.

For more data **circle No. E1** on Readers' Service Card, last page this issue.

Resistance Meter

The Model C-6 resistance meter is a new addition to the Southwestern Industrial Electronics Company ohmmeter line. Through the use of the "quick charge" switch and the "charge adjust" control, it is possible to pre-set an acceptable value of capacitor leakage resistance into the meter and determine almost instantaneously whether or not a capacitor meets the requirement, thus using the instrument as a "go-no-go" gauge. Either 50 or 500 volts DC may be used in measuring resistance in the megohm range. The 500-volt test meets JAN and MIL specifications for insulation testing, while 50 volts is provided in order that condensers may be tested for leakage without exceeding their voltage limitations.

For more data **circle No. E2** on Readers' Service Card, last page this issue.

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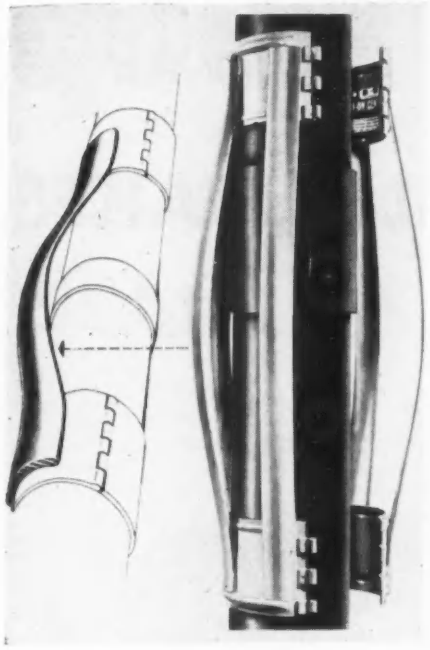
DRILLING



Latch-On Centralizer

The centering ability of the B and W latch-on centralizer has been increased with the introduction of the KON-KAVE bow. The curved cross section of each bow provides strength and resistance to deformation or breakage. Higher quality spring steel is hot formed by drop forging, to exact specifications and the normal heat treatment to develop the full strength of the alloy spring steel is supplemented by a later special heat treatment that removes stresses caused by welding the bows to the end collars.

(This item supplements B and W Incorporated data on pages 341-348 of the Composite Catalog, 20th Edition.)

For more data **circle No. E3** on Readers' Service Card, last page this issue.

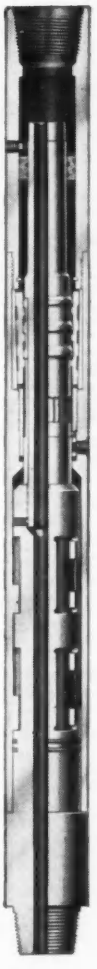
Tool Tray

Made with a new built-in folding tool tray that eliminates all lose parts, the new Ridgid 40A tristand pipe vise has been announced by the Ridge Tool Company. This tray pushes down flat for easy set-up and extra rigidity of vise stand; and pushes up easily to fold in and chain the legs for easy carrying to the job. New design full-size base overhangs front legs to give clearance for threader handles. Entire stand is extra light and rugged, and is equipped with three pipe benders, ceiling brace screw, pipe rest and lots of tool hanging slots.

For more data **circle No. E4** on Readers' Service Card, last page this issue.

Jar Safety Joint

Sealed type I Bowen jar safety joints are filled with oil and sealed top and bottom. The sealed construction enables the tool to transmit circulating fluid at any pressure and they prevent any contact between the well fluid and the working parts of the tool. The moving parts work in a bath of oil.



The tripping tonnage does not increase or decrease regardless of the presence of sand or oil in the well fluid. The tripping tonnage can be varied only at the will of the operator. The oil bath extends the life of the friction slip and friction mandrel and practically eliminates wear on any other parts. These jars can be used to perform several jobs before it is necessary to service them. The floater automatically moves up or down the washpipe maintaining a pressure balance within the tool and avoiding excessive pressure on the seals.

These safety joints are compact combination units designed to provide services of both rotary jars and safety joints. They are installed as safety devices in strings during testing, coring, reaming, drilling, sidetracing and washing over operations and are also used during fishing operations. They will either deliver heavy upward or downward blows against a stuck string or fish, or they can be disengaged to salvage all that is above them.

(This item supplements S. R. Bowen Company data on pages 753-800 of the Composite Catalog, 20th Edition.)

For more data **circle No. E5** on Readers' Service Card, last page this issue.

Balanced Power Slip

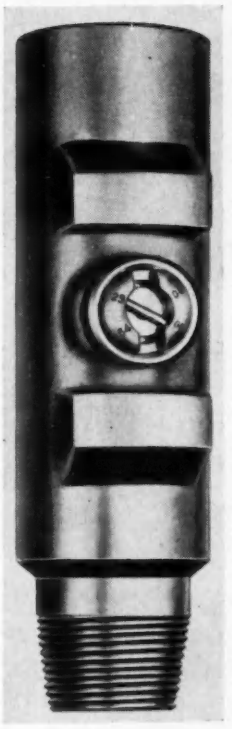
Manufacture and sale of the power slip previously manufactured by the DeLaney Company have been taken over by Web Wilson Oil Tools, Inc., and will be sold under the name "Web Wilson balanced power slip." It is recommended for use on tubing, drill pipe and casing up to seven inches in diameter. Field warehouse stocks of all replacement parts will be carried for the many present owners of this power slip and parts to be manufactured by Web Wilson Oil Tools, Inc., will be interchangeable with parts now in use.

Air pressure commonly available on drilling rigs is suitable for operation and as only a small volume of air is required, no increase in compressor capacity is needed. Exclusive Web Wilson slip buttons ensure safe, positive gripping and economical operation. When not in service, the assembly can be lifted on the catline and set on a special stand (furnished with the slips) anywhere on the derrick floor; or the slips can be swung out of the way in the conventional manner. Installation, operation and servicing are simple.

(This item supplements Web Wilson Oil Tools, Inc. data on pages 5165-5192 of the Composite Catalog, 20th Edition.)

For more data **circle No. E6** on Readers' Service Card, last page this issue.

Hydraulic Tubing Drain



The Page Oil Tool Type B hydaulic tubing drain is designed for use in shallow fields where the tubing is generally unanchored. The tubing can be drained simply by applying additional pressure at the surface with a hand pump. When approximately 1000 pounds of pressure has been applied, the hydraulic piston in the drain overcomes a shear pin which allows the fluid column to drain out at a restricted flow. Two advantages are achieved when a well is equipped with this drain: wet jobs and stripping jobs are eliminated, minimizing fire hazards and undesirable working conditions; and the fluid column can be drained back into the well under a restricted flow thus avoiding the severe hydraulic action applied to the formation under the conventional procedures.

The Type B tubing drain features a replaceable shearing unit which gives longer life to the tool. This unit houses a hydraulic piston, shear pin and proper O-ring seals. Its purpose is to confine the cutting action of the fluid to its interior thus protecting the main body of the drain. It is held securely in place by six Allen set screws. This unit should be replaced each time the drain is used.

(This item supplements Page Oil Tool data on pages 4041-4060 of the Composite Catalog, 20th Edition.)

For more data **circle No. E7** on Readers' Service Card, last page this issue.

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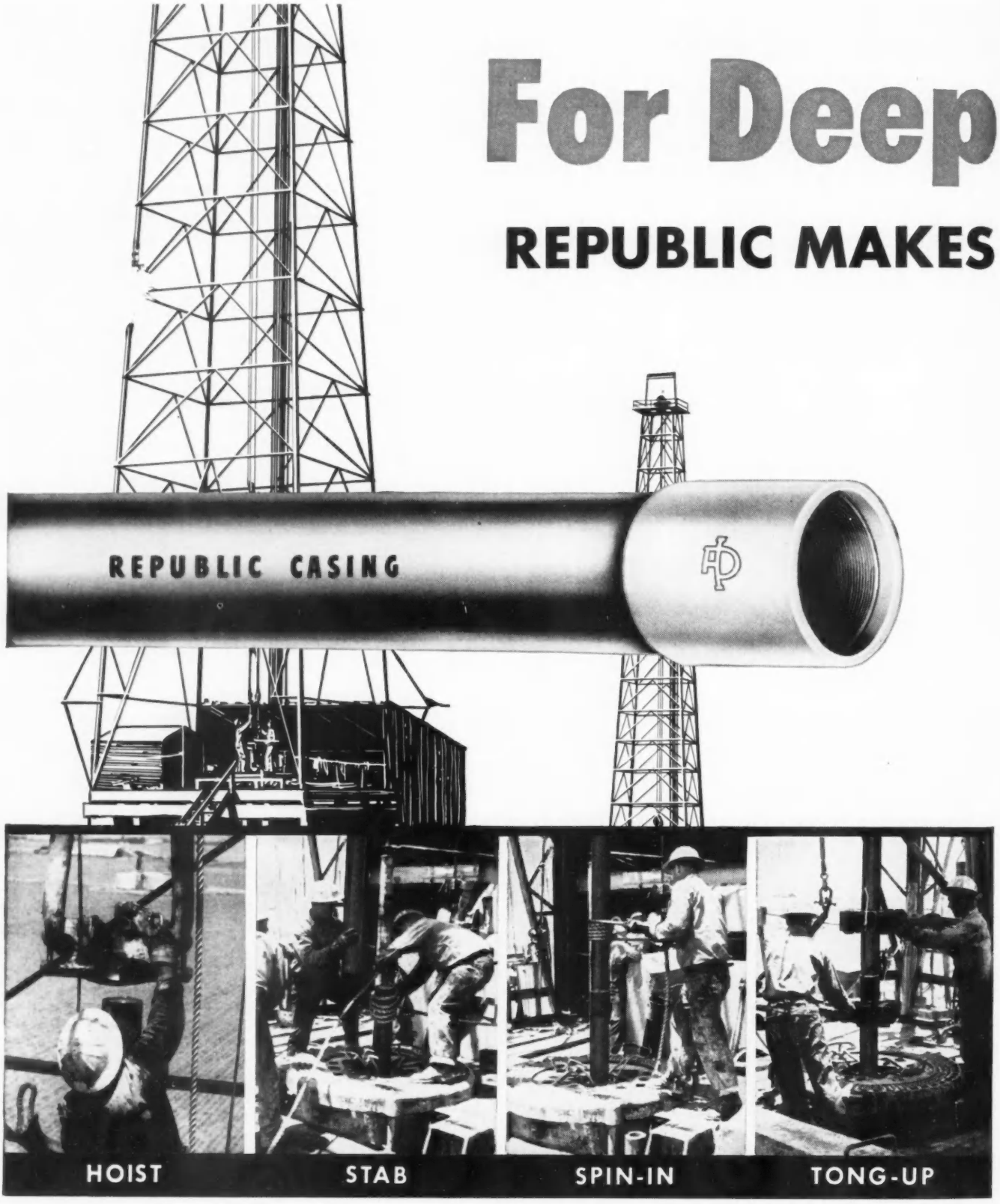
For Deep

REPUBLIC MAKES



24-page picture booklet takes you on quick trip through Republic's new seamless mill. Ask for No. ADV 595.

Republic Casing and Tubing make up quickly. Straight lengths together with uniform roundness mean quick, easy stabbing. Clean, accurate threads spin in and tong up fast. And uniform depth of steel under thread roots guards against pullouts—gives full protection in the hole. To save time and money, specify Republic.

or Shallow Wells

BOTH ELECTRIC WELD and SEAMLESS CASING and TUBING

Specifically, what does this mean to you in the oil business?

It means that when you purchase Republic Electric Weld or Seamless Casing and Tubing you're assured of the same high quality throughout the string—quality that has earned an outstanding reputation in the oil industry throughout the world. The reason is clear. Oil producers know they're protected by Republic's rigid quality controls—that Republic strings are dependable, economical.

Republic's Normalized Electric Weld Casing and Tubing, widely used in every field for the past 25 years, are available in grades H-40 and J-55. Sizes range from 2⅜" through 13⅜" O.D.

Republic Seamless Casing and Tubing, newest additions to the line, are second to none in the industry. They're produced at the world's most modern seamless mill, employing the latest precision equipment and techniques—made in grades J-55 and N-80. Sizes range from 2⅜" through 9⅝" O.D. For complete information, call your nearest Republic sales office. Or write to:

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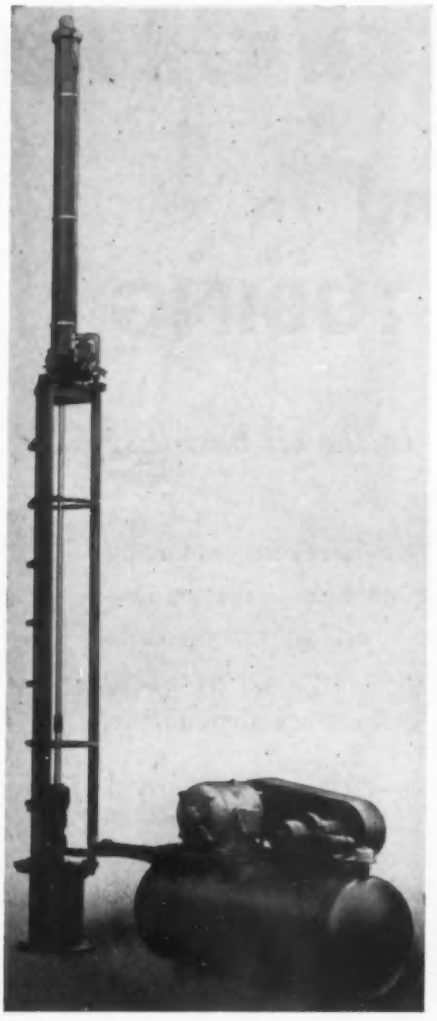
PRODUCTION



Hydraulic Pumping Unit

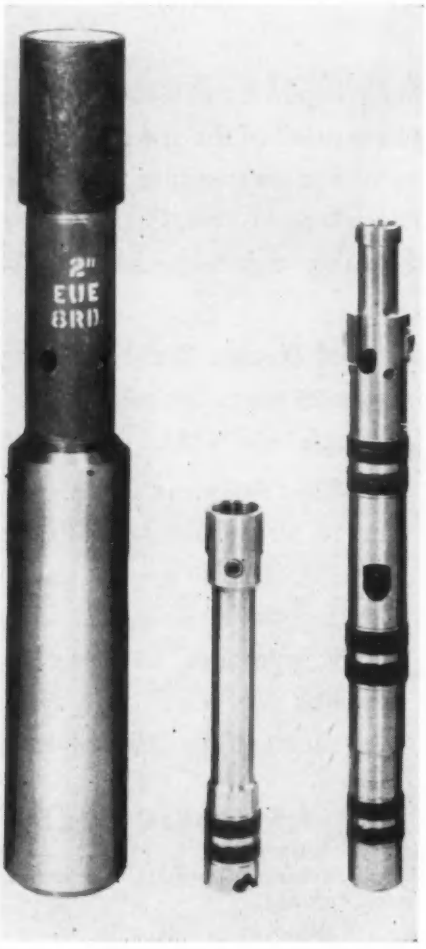
Axelson has introduced a new six-foot stroke hydraulic pumping unit which has been successfully field tested. This is the first surface unit developed by Axelson engineers since the Axelson long stroke hydraulic pumping unit was introduced in 1948. An almost constant oil flow is possible because the unit combines a fast downstroke with a slow upstroke, thus increasing volumetric efficiency of the subsurface pump. Axelson's hydraulic reversal valve (patent applied for) assures a gentle reversal action which is easy on sucker rods. Other features include a relief valve placed in the discharge line of the positive displacement pump to supply positive protection against excessive pressure build-up caused by surface or sub-surface equipment.

The cylinder base may be called the "heart" of the unit. The unit rested stroke to the bottom of the base, the cylinder into the top portion and the reverse valve assembly attaches to one side. Both power and exhaust fluids are ported through the cylinder base. Another feature is the ability to assure adequate pressure at lower reversal, which assures operation of the pilot valve.

Reverse valve and pilot valve are both hydraulically operated. Only three pressure lines feed into the pilot valve. One is internally constructed to one end and two to the other. Each pressure source operates on different area. The tripod base allows spacing of the sub-surface pump by insertion of sub-couplings between the well and unit polished rod. One leg of the base is used for porting high pressure fluid while a second leg carries discharge fluid from cylinder base back to the fluid reservoir. An important feature of this mounting assures no contamination of the hydraulic fluid.

(This item supplements Axelson Manufacturing Company, Division of Pressed Steel Car Company, Inc. data on pages 297-340 of the Composite Catalog, 20th Edition.)

For more data **circle No. E8** on Readers' Service Card, last page this issue.



Vari-Flow Head

The Vari-Flow head, designed as a completion and production tool for dually-completed wells, will permit the operator, at his option, to produce the well as a standard dual completion or with the flow courses crossed over by interchanging two flow sleeves, under pressure if desired, with ordinary wire line tools.

The equipment manufactured by Pressure Services, Inc. for this type of work consists of three basic pieces: the vari-flow nipple assembly attached immediately above the upper packer and run into the well with the tubing string; the straight through sleeve, a retrievable tool run and pulled with wire line tools; and the crossover sleeve, a retrievable tool run and pulled with wire line tools. When the straight through sleeve is landed in the nipple of the vari-flow head, the flow courses are as in a regular dual completion, i.e. the upper horizon is produced through the tubing-casing annulus, the lower horizon is produced through the tubing. As the crossover sleeve is landed in the nipple of the vari-flow head, the fluid courses become crossed over, i.e. the upper horizon is produced through the tubing, the lower horizon is produced through the tubing-casing annulus.

The tool is capable of changing the flow of the zones from the straight through to the crossover position without removing the pipe from the well, killing the well or disturbing the packer and wellhead. It provides a tool with large flow passages designed for remedial work and furnishes the industry with a locking device and fishing neck that are constantly cleaned with flow. Manufactured by Pressure Services Inc., the tools are supplied for standard casing and tubing sizes and are adaptable to standard make packers.

For more data **circle No. E9** on Readers' Service Card, last page this issue.

Water Coolers

Recessed push-button faucets, flush mounted, are now available on all sizes of Gotkool water cans and water coolers, products of H. P. Gott Company, except 15- and 20-gallon sizes. This convenient, sanitary faucet, which is available at no extra charge, is easily accessible to workmen with large hands even while wearing gloves. The recess is pressed into the body of the container, thereby leaving no seam to lose insulation efficiency. The previously available Gotkool water cans and water coolers with the extended type faucets are still available. For additional information on these products, just . . .

For more data **circle No. E10**, on Readers' Service Card, last page this issue.

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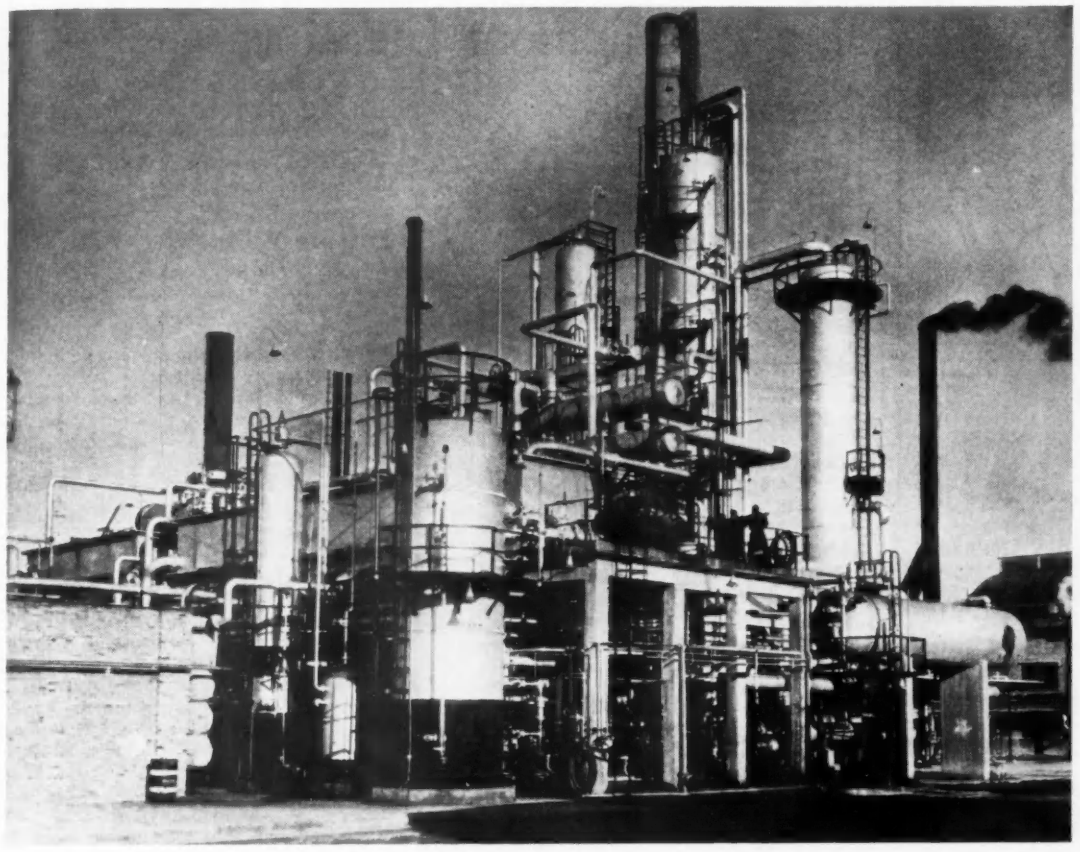

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A typical refinery in Europe showing use of various types of Dalmine tubing.

Dalmine Seamless Mills provide every type of tubing and piping from the smallest up to 32½ O.D. Expert technicians — with years of experience in all branches of oil transmission and refining — will give their skilled attention to any problem you care to submit.

Dalmine's installations throughout the world have long enjoyed a dependable reputation among the most careful builders. From hypodermic size tubing to that large enough to accommodate torpedoes, no problem has proved too small or too large for their engineers. Skilled laboratory technicians exercise complete control over Dalmine products.

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Rainbo Service Co. - ME 4-2131, ME 2-2024
SHREVEPORT
Tuboscope - - - - - - - - - - - - - 8-2336

New Equipment Literature

Acidizing Bulletin

Dowell Incorporated has just published a bulletin on acidizing at high temperatures. Of a case history nature, this bulletin describes the problem, the method, the effects of Dowell's high temperature inhibitor and the results of the treatment.

To get a copy, **circle No. E11** on Readers' Service Card, last page this issue.

Hose and Belt Brochure

A new brochure designed to aid the oil industry in choosing the proper types of hose and belts for specific operations has been issued by the Goodyear Tire & Rubber Company. New applications of Goodyear hose are fully cataloged according to specific duties, special features, available sizes and actual construction designs. The brochure includes information on flat belting, V-belting and sheet packing.

To get a copy, **circle No. E12** on Readers' Service Card, last page this issue.

Oil Field Equipment

Worthington Corporation is now offering a new bulletin, graphically illustrated with application photographs on oil field equipment. The bulletin contains specification information on many types of pumps, including those for water flooding; steam turbines and turbine-generators; oil, gas and dual fuel engines; "packaged" oil field compressors; various types of air and gas compressors; air tools and mechanical power transmission equipment.

To get a copy, **circle No. E13** on Readers' Service Card, last page this issue.

Engine Bulletin

"Air For Your Engine" is the title of a new bulletin recently published by Cummins Engine Company in the interest of better diesel engine maintenance. This informative booklet illustrates the effects of dirt and improper air temperature. In addition to pointing out these hazards, it further describes what can be done about correcting them. Also included in this booklet is a convenient air cleaner maintenance check-off sheet.

To get a copy, **circle No. E14** on Readers' Service Card, last page this issue.

Valve Bulletin

A comprehensive, completely illustrated four-page circular describing Iron Body Bronze Mounted Grooved End Valves for grooved end couplings has just been published by The Lunkenheimer Company. The bulletin describes the Lunkenheimer grooved end valves, available in 2½ to 8-inch sizes in standard 200-pound W.O.G. gate valve patterns and in a 2-inch size 225-pound W.O.G. "King-clip" pattern. Also included are dimensions and price lists.

To get a copy, **circle No. E15** on Readers' Service Card, last page this issue.

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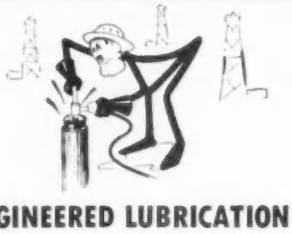

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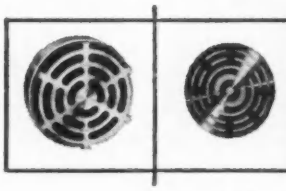

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Peak performance, maximum efficiency, greater output, and lower power costs can be built into your oldest, and of course your newest, compressors by the installation of VOSS VALVES.

Check THESE VOSS VALVE ADVANTAGES:

✔ Quiet, vibration-free operation ✔ 20 to 60% more valve area ✔ less power consumption ✔ minimum pressure loss ✔ normal discharge temperature ✔ lower operating costs ✔ utmost safety

Our detailed proposal for increasing the efficiency of your compressor will be sent you without obligation. Send us the name, bore, stroke, and speed of your machine.

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Where corrosion resistance is vital

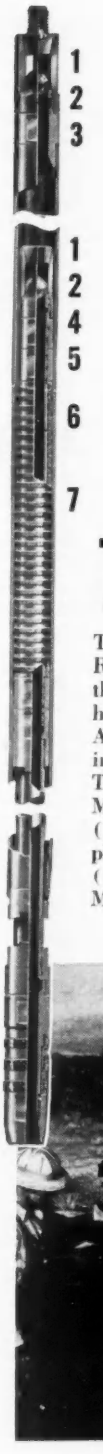
Several years ago, it looked as if a 4200-ft. sour crude well in West Texas would have to be abandoned. The reason: the high sulfur crude was corroding out the pumps too fast. Finally, to hold the lease, the operators decided to try a pump made of Monel®. Using a Harbison-Fischer pump, the well was successfully operated for 18 months. At the end of that time, the well was practically exhausted and no longer economical to operate. But not the pump — when it was removed, threads and working parts were found to be in excellent shape!

Given a new barrel, the pump was installed in another corrosive well, in Arkansas. At last report, it had given one year of additional service. Many similar Harbison-Fischer pumps of Monel construction have served in corrosive wells for four years or longer.

This is only one example of how Monel and the other Inco Nickel Alloys are used to solve tough oil field equipment problems. If your problem involves corrosion by sour crude, brine or acids — or heavy wear, or the physical punishment that most oil field equipment is subject to, it will pay to look into the possibilities of the Inco Nickel Alloys.

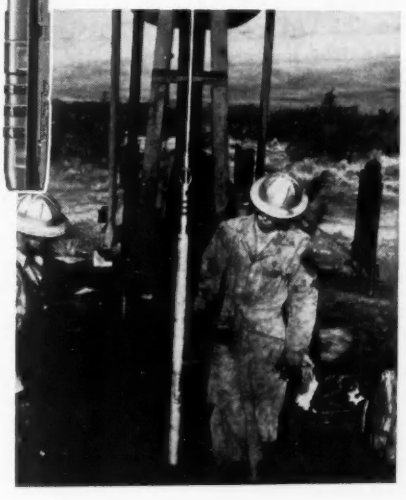
At present, it is advisable to place equipment orders with your supplier well in advance of scheduled use. Distributors of Inco Nickel Alloys can supply the latest information on availability from warehouse and mill.

The International Nickel Company, Inc.
67 Wall Street, New York 5, N. Y.



7 vital pump parts are made of Monel

The special feature of the Harbison-Fischer "Flexite" Rod Pump is the Flexite rings. Precision-ground to fit the barrel tube exactly, the rings are made of a special hard plastic composition impregnated with graphite. According to the manufacturer, they do not require soaking or prefitting, and will not corrode or disintegrate. They make worthy companions to the corrosion-resisting Monel used for other component parts, such as: cages (1), balls and seats (2), barrel (3), seat frame (4), plunger locknut (5), plunger tube (6), and spacer rings (7). For further information, write to Harbison-Fischer Manufacturing Company, Box 64, Fort Worth, Texas.



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It is a wise man who takes advantage of the experience of others. Most oil industry men are Busy Men—busy with their own appointed tasks. Keeping abreast of developments in the industry is vital for growth and greater earning power.

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The knowledge gained through years of work and study by capable men in the oil production industry has been recorded for your use. Profit through the experience of others by ordering the books of practical job-interest value to you.

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  By Walter F. Rogers price $10.00
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  By John C. Calhoun, Jr. price $6.00
- ***Oil & Gas Production***
  Compiled by Engineering Committee, Interstate Oil Compact Commission. price $2.75
- ***Oil Property Valuation***
  By Paul Paine price $4.00
- ***Practical Accounting for Oil Producers***
  By Robert M. Pitcher price $9.50
- ***Petroleum Production Engineering—Oil Field Exploitation***
  By Lester C. Uren price $10.00
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  By J. E. Brantly price $10.00
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  By Bruce H. Sage and William N. Lacey price $5.00
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Diesel Engines

Lister stationary diesel engines, five models of 9 to 54 bhp. with one to six cylinders are described in a new eight-page illustrated bulletin by The National Supply Company. Design features, specifications and dimensional diagrams are included.

To get a copy, **circle No. E16** on Readers' Service Card, last page this issue.

Equipment Bulletins

Black, Sivalls & Bryson, Inc. announces the publication of three new oil field bulletins, two on emulsion treaters and one on glycol type dehydrators. Bulletin 31-02 describes the Model S Treater; bulletin 31-04 describes the Model SCW Treater, a cold weather modification of the Model S; bulletin 34-03 describes the BS&B Glycol-type Gas Dehydrator. Each of these bulletins features color flow diagrams, dimensional drawings and gives complete descriptions of the models.

To get a copy, **circle No. E17** on Readers' Service Card, last page this issue.

Lubrication Catalog

A catalog of lubrication equipment especially designed for the servicing of lubricated valves has just been published by the Alemite division of Stewart-Warner Corporation. Various types of lubrication fittings, which are inserted in the same threads in place of existing lubricant screws on lubricated valves; special extra heavy duty lubrication guns, both lever and bucket types; hose assemblies, follower plates, pressure gauges and other accessories are covered in the catalog.

To get a copy, **circle No. E18** on Readers' Service Card, last page this issue.

Lost Circulation Bulletin

Uses and properties of Palco Seal, a fibrous redwood product specially processed to prevent loss of circulation in drilling muds, are described in a new bulletin just released by The Pacific Lumber Company. The availability of this material in loosely packed 40-lb. bags, as well as 80-lb. bales, has also been announced. In addition to description of the material, manufacturing techniques, and application information, the new bulletin contains graphs showing comparative sealing efficiency test data procured under rigidly controlled conditions.

To get a copy, **circle No. E19** on Readers' Service Card, last page this issue.

Pumping Unit Catalog

A new eight-page, three-color catalog describing Vickers Heavy Duty Long Stroke Hydraulic Oil Well Pumping Units is now available from Vickers Incorporated. The illustrated catalog describes two models of self-contained mechanisms that actuate conventional sucker rod string and subsurface pumps at a constant rate with shockless controlled reversals. Dimensional drawings and suggested foundation layouts are given for two 125-horsepower units—the model JV-20400-AV that provides seven 20-foot strokes per minute, and the Model JV-30400-AV that provides six 30-foot strokes per minute.

To get a copy, **circle No. E20** on Readers' Service Card, last page this issue.

Reduce the RISK of check valve failure

Risk of check valve failure is counted in dollars spent for string pulls, and dollars you can't spend because of lost production. Kennametal Balls and Seats give you excellent insurance for this risk because they resist shock, sand-cutting, corrosion, and pitting up to 5 times as well as "special" alloys. Most well-known pumps use Kennametal Balls and Seats as standard equipment.

Kennametal Balls and Seats (either flat or rib type) are sold by your regular supplier, in A.P.I. specifications. Kennametal Inc., Latrobe, Pa.

KENNAMETAL *LIGHT-WEIGHT* **BALL**

Made of corrosion-resistant titanium carbide, ⅓ lighter than steel. Minimizes down-well check valve trouble caused by ball flutter, cage wear, and fluid pounding.

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K & G Magnetic Fishing Tools have been accepted by fieldmen, after thousands of successful runs, as the most practical and economical tools for removing hard-to-recover metallic junk lost in the hole.

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Ventura, Phone Miller 3-6767

ILLINOIS:
Olney, Phone 5226

KANSAS:
Great Bend, Phone 7819
Liberal, Phone 3222

LOUISIANA:
New Iberia, Phone 2-8175

MISSISSIPPI:
Natchez, Phone 5872

NEW MEXICO:
Farmington, Phone DA 5-5162
Hobbs, Phone 3-5546

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Oklahoma City, Phone ME 7-2555
Velma, Phone 91K52

TEXAS:
Abilene, Phone 4-7427
Corpus Christi, Phone 4-4191
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The Centrifugal Casting and "Heat Tensioning" methods used by France have proved: here are Piston Rings that assure you longer life and efficient oil control with no warping or loss of tension in service.

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Aluminum alloy castings . . . high strength, light weight. Worm gear drive . . . easier turning, longer gear life. Drive gear of finest bronze. Bearing-supported shafts for proper alignment. Self-lubricated bearings . . . no maintenance necessary. NOW available: Model 152 for 2-15 ml tubes. Model 1002 for 2-100 ml tubes.

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New Structural Contour Map of Oklahoma-Texas Area Available

A DETAILED structural contour map of Oklahoma (west of Tulsa) and adjoining oil provinces in Texas was published recently and made available to the oil industry by Dr. Robert R. Wheeler, consulting geologist of Dallas. Such a map has long been needed and although it is based upon tens of thousands of wells drilled in the region and is therefore much more densely contoured than The Structural Map of Texas, published by the Texas Bureau of Economic Geology, it serves the same desirable purposes. These include perspective, such that the geologist and oil operator may better visualize the position of major structural provinces in the region and local aspects of faulting, structural trends and regional dip; a sectionized base map for the operators, landmen and scouts following lease plays and wildcat drilling ventures; and structural complexity which has a direct bearing upon the depth, rate of dip and other factors influencing the cost of drilling.

Map Data. In Wheeler's explanation of the map it is noted that an area of 76,000 square miles has been contoured using the most significant horizons that the depth, abundance of wells, and contour spacing allows in each province. The principal map datum was the Ordovician, Viola limestone, but successively older Ordovician horizons were used where the Viola is truncated; elsewhere, the base of Des Moines-Deese unconformity is widely used in southern Oklahoma, the top of the Mississippi in northwestern Oklahoma and other datums where they were more important locally.

Detailed Analysis. It is intended by the author that one effect of the map will be to stimulate more detailed analysis of structural leads and trends by a more careful scrutiny of local subsurface data not only in the continuing search for structural and wedgeout possibilities in central Oklahoma but across the far flung flanks of the Anadarko Basin which are now considered the great hope of future Oklahoma gas and oil production.

The map is for sale at $27.50 per copy, mailed in tube, by Robert R. Wheeler, 3140 Amherst Street, Dallas, Texas.

INCREASE PRODUCTION

CLEAN OUT CHOKING SAND

Excessive sand and sediment holds back your oil. For fast, easy clean out with fewer round trips and less down-time, use world famous Miller Sand Pumps.

PUMP & BAILER SIZES
O.D.—2½, 3, 3½, 4¼, 5, 5½, 7 inches.
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Composite Catalog Page 3433

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MP straight centrifugal pumps have always been demanded for tough, exacting jobs. On beach-heads and in oil fields, MP pumps have proven they can take it.

- All Bronze Corrosion Resistant Construction.
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- Belt Drive from any power source.
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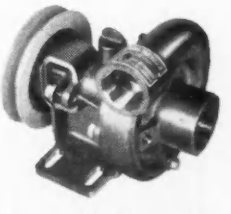

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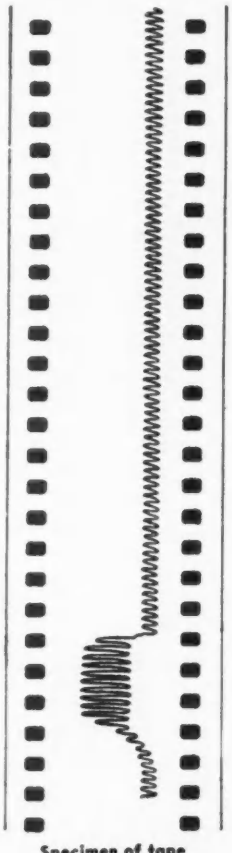

Specimen of tape indicating saturation

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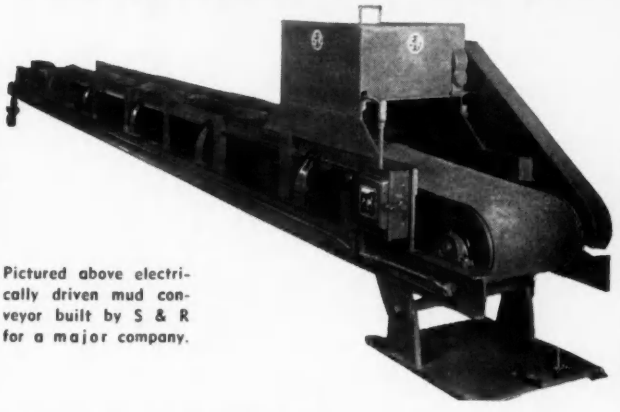

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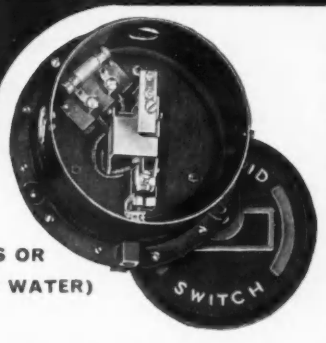

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Mercoid Type PPQ Diaphragm Differential Pressure Controls operate from minute changes (.03" water) in the difference between two pressures.

Ranges to cover most applications (inches of water) 6" vacuum to 6" pressure, and 30" vacuum to 30" pressure. Available for various circuit arrangements.

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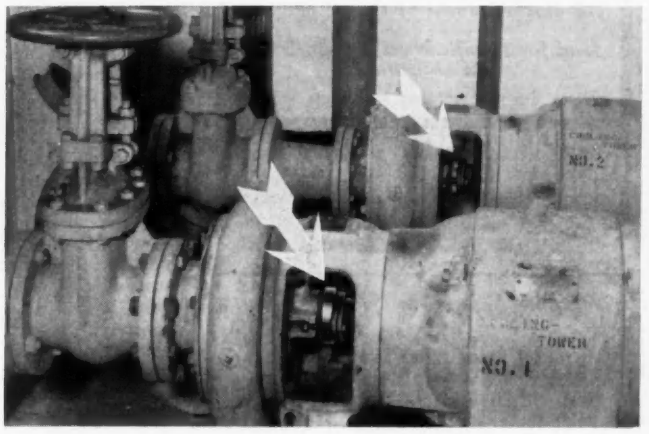

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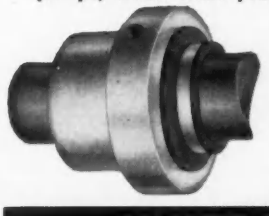
Installed on the rotating shafts of huge cooling plant pumps, these seals provide positive, trouble-free sealing after more than two years of continuous service. Available in models and sizes for nearly all types of rotating shafts, Syntron Seals are self-lubricating, easy to install, do not score the shaft.



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New Books, Maps and Movies

THREE STARS FOR THE COLONEL, James A. Clark, Random House, New York, N. Y., $4.

"Three Stars for the Colonel" is the title of a new book by James A. Clark, one of the co-authors of the fine book, "Spindletop." Clark's new book is a biography of Colonel Ernest O. Thompson, whose outstanding service on the Texas Railroad Commission has contributed greatly to the oil business, not only in Texas, but throughout the U. S. Author Clark had a splendid subject in the colorful colonel, but we must admit that in our opinion the colonel has done a better job than his biographer.

To one who has watched the API since its organization, Author Clark takes liberties with the actions and aims of the API which we do not think are warranted. But despite this, "Three Stars For The Colonel" is well worth reading.

•

ROTARY DRILLING FLUIDS, American Petroleum Institute Division of Production, 300 Corrigan Tower Building, Dallas.

A print of this new motion picture is available on loan for industry use from the API Dallas office. The film is designed solely to supplement courses or discussions on rotary drilling fluids. The movie was produced by the University of Texas with the aid of an Advisory Committee consisting of members of the Southwestern District Committee on Drilling Fluids of the API Production Division. It was validated by the API and the American Association of Oilwell Drilling Contractors. In sound and color the 16-millimeter film is 37 minutes in length. It deals with control and testing of drilling fluids during operation and contains some background information on the source of materials used to condition mud.

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THE GROWTH OF INTEGRATED OIL COMPANIES, John G. McLean and Robert William Haigh, Division of Research, Harvard Business School, Soldiers Field, Boston 63, Mass. $12.

This book is a study of the process of progressive adaptation which has resulted in the gradual emergence of large, integrated companies as the predominant form of business organization in the oil industry. The authors examine the structure of the oil industry as it existed in 1950, the technological, economic and business circumstances which have encouraged vertical integration. Parts 3 and 4 deal with the structures of a selected group of oil companies, the nature of the managerial process by which the companies have adapted their structures to new conditions, and the changes which have taken place in the participation of small business in the refining segment of the industry between 1920 and 1950. The reader is left free to draw conclusions concerning the social and economic consequences of vertical integration and the kinds of structures the oil companies should be permitted to retain in the future.

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FIELD STUDY OF THE BEAVER LODGE-TIOGA POOL AREA, 1954 IN NORTH DAKOTA, North Dakota Geological Society, P. O. Box 1123, Bismarck, N. D. $12.50.

This report includes two structural contour maps of the Beaver Lodge-Tioga fields on Cretaceous and Mississippian horizons, and five electric log and microlog producing zone cross-sections with testing and completion data shown on the logs.

TENTATIVE STANDARD FOR FIELD WELDING OF PIPE LINES, Second Edition, American Petroleum Institute, 50 West 50th Street, New York 20. 50 cents.

The revised edition incorporates certain changes resulting from comments on the first edition issued in January, 1953. Principal changes are in the radiographic section where extensive revisions have been made. The standard and its latest revision were prepared by a committee on which serve representatives of the American Gas Association, Pipe Line Contractors Association, National Electric Manufacturers Association and the American Petroleum Institute.

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METALS AND HOW TO WELD THEM, T. B. Jefferson, Editor, The Welding Engineer, Gorhan Woods, metallurgist, The James F. Lincoln Arc Welding Foundation, Cleveland 17, Ohio. $2 in U. S.; $2.50 elsewhere.

A new book for the welding operator, supervisor, instructor, engineer, designer, and manager; explains in readily understood steps the structure and properties of metals and how to weld them; covers the fundamentals of metallurgy and their significance for welding metals. Procedures for welding mild, medium and high carbon steel, alloys, cast iron, hardfacing, stainless and high chromium steels, austenitic manganese steels, tool and die steels, how to make good welds, trouble shooting, welding terms and useful data are given. It contains over 170 drawings, photographs and tables.

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